2005
GROUND WATER ANNUAL REPORT
THE ENSIGN-BICKFORD COMPANY
SPANISH FORK, UTAH

Prepared for:

The Ensign-Bickford Company
Spanish Fork, Utah
and
The Spanish Fork Technical Committee

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EXECUTIVE SUMMARY

In May 2002, on behalf of The Ensign-Bickford Company (EBCo) and the Spanish Fork Technical Committee, Charter Oak Environmental Services, Inc. (Charter Oak) submitted a Corrective Action Plan (CAP) for the recovery and treatment of ground water contained within the regional unconsolidated aquifer in the vicinity of the EBCo site in Spanish Fork, Utah. The CAP presents a detailed assessment of hydrogeologic and water quality conditions in the Spanish Fork Study Area and provides a detailed description and assessment of corrective actions that have been implemented. The CAP also proposes an ongoing monitoring program to assess water quality conditions in the study area and to evaluate ground water recovery and treatment system operations.

This Annual Report provides a summary of ground water recovery and treatment system operations and ground water monitoring data for the calendar year 2005.

No new monitoring wells were installed in 2005 nor have any new private wells been added to the monitoring program. In August 2005, a pump test was performed on the privately owned Booth well to evaluate aquifer characteristics and well yield.

Other than periodic maintenance and repair shutdowns, the five extraction wells were operated at maximum sustainable capacity during 2005, with the exception of the R-2 well. The R-2 well was operated on a very limited basis between January 2005 and August 2005 because the underground telephone lines necessary to safely operate and control the well were damaged by excavation equipment.

The extraction system monitoring program was implemented in accordance with the CAP and amendments thereto approved by the DWQ.

The granular activated carbon (GAC) treatment system monitoring was conducted in accordance with the CAP and amendments thereto approved by DWQ. Based on these data, four carbon exchanges were completed during 2005.

The ground water quality monitoring program was implemented in accordance with the CAP and amendments thereto presented in the 2004 Annual Report (Charter Oak, 2005). Several wells could not be sampled at certain times due to winterization, repair needs and physical access impediments. In addition, fourth quarter sampling of perched ground water monitoring wells was not completed due to nearby construction activities related to soil interim measures.

The UPDES monitoring program was performed in accordance with the UPDES permits. UPDES discharge monitoring data were within Permit limits during 2005.

Written notification of water quality results was provided to private or municipal well owners in accordance with the institutional controls plan presented in the CAP. Also, in accordance with the institutional controls plan, a review of water rights records was completed to determine if any new water supply wells were constructed within the study area. No new perfected water rights were identified in 2005 that indicated new well locations within areas of known or suspected ground water impacts.

The CEM compounds 2,4,6-TNT, 2,4-DNT, 2,6-DNT and NG were not detected in any wells open to the regional unconsolidated aquifer during four quarters of monitoring in 2005.

No changes to the monitoring program are recommended at this time.

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2,4-DNT	2,4-Dinitrotoluene
2,6-DNT	2,6-Dinitrotoluene
BTTN	Butanetriol Trinitrate
CACL	Corrective Action Concentration Limit
CAP	Corrective Action Plan
CEM	Constituents of Energetic Materials
COC	Constituent of Concern
DDW	Division of Drinking Water
DEGDN	Diethylene Glycol Dinitrate
DEQ	Department of Environmental Quality
DNR	Department of Natural Resources
DWQ	Division of Water Quality
DWR	Division of Water Rights
DSHW	Division of Solid and Hazardous Waste
EBCo	The Ensign-Bickford Company
EGDN	Ethylene Glycol Dinitrate
EPA	United States Environmental Protection Agency
ES	Engineering Science
HA	Health Advisory
HI	Hydrogeologic Investigation
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MWH	Montgomery Watson Harza
NG	Trinitroglycerol (nitroglycerin)
PETN	Pentaerythritol Tetranitrate
RBCL	Risk-Based Concentration Limit
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RF	Regeneration Facility
RFI	RCRA Facility Investigation
SMCL	Secondary Maximum Contaminant Level
SWMU	Solid Waste Management Unit
TEGDN	Triethylene Glycol Dinitrate
TMETN	TrimethylolethaneTrinitrate
TNC	Tetranitrocarbazole
TNT	2,4,6-Trinitrotoluene
TSNE	Total Specialty Nitrate Esters
USGS	United States Geological Survey

1.0 ABOUT THIS DOCUMENT

This Annual Report summarizes 2005 data collection and analyses activities for the operation and monitoring of ground water recovery and treatment facilities at and in the area of The Ensign-Bickford Company (EBCo) site in Spanish Fork, Utah. The ground water recovery and treatment facilities are described in detail in the Corrective Action Plan (CAP) (Charter Oak, May 2002) as amended in August 2004 (Charter Oak, 2004b). In addition, this Annual Report serves as a vehicle to present new hydrogeologic data collected over the previous year. This Annual Report focuses on the following major topics:

- Presentation of water quality and water level data
- Review of extraction well operations and performance
- Summary of granular activated carbon treatment system performance
- 2005 institutional controls assessment
- Recommendations for future operations and monitoring

1.1 Key Terminology

Several key terms are used throughout this document. These terms, described in detail in the CAP, are defined as follows:

Study Area – The area of interest addressed by the CAP. The Spanish Fork River in the south, Hobble Creek in the north and the edge of the Wasatch Mountains to the east approximate the boundaries of the study area. The western boundary of the study area is considered to be just beyond the edge of ground water impacts.

Regional Unconsolidated Aquifer – A heterogeneous assemblage of saturated materials located in the unconsolidated basin-fill deposits west of the Wasatch Mountains. Also called the "*Regional Aquifer*" or "*Regional Ground Water Aquifer*."

Deep Regional Aquifer – As defined in the CAP the deep regional aquifer represents the portion of the regional aquifer below an elevation of approximately 4,450 ± 50 feet. The Regional Aquifer is considered to be one aquifer having lateral and vertical heterogeneity. The qualifier "deep" does not indicate a separate aquifer.

Shallow Regional Aquifer – As defined in the CAP, the shallow regional aquifer represents portions of the regional aquifer from the top of the zone of saturation (regional water table) to an approximate elevation of 4,450 ± 50 feet. The Regional Aquifer is considered to be one aquifer having lateral and vertical heterogeneity. The qualifier "shallow" does not indicate a separate aquifer.

Mapleton Bench – A topographic feature present throughout much of the study area. It represents an area of highlands that lies between the Wasatch Mountains to the east and the lower elevation lake plane to the west.

Mapleton Bench Ground Water System – A perched ground water system present within the area of the Mapleton Bench. The ground water is perched on a laterally continuous clay layer that underlies the Mapleton Bench and separates the Mapleton Bench ground water system from the underlying regional aquifer. The Mapleton Bench ground water system is not part of the regional unconsolidated aquifer.

Perched Ground Water – Ground water that is present in deposits above the top of the zone of saturation of the regional unconsolidated aquifer. If present, perched ground water generally collects on the top of less permeable layers. Perched ground water may or may not be a perched aquifer. The term aquifer applies to only those saturated deposits where sufficient water is consistently present and/or extractable to allow beneficial use of the ground water resource.

Constituents of Energetic Materials (CEMs) – A suite of chemical compounds related to the production of blasting products at the EBCo site.

Corrective Action Concentration Limit (CACL) – A cleanup standard for constituents that do not have established ground water quality standards. CACLs may be based on existing state or federal water quality standards, health advisories, risk-based concentration levels or other relevant information. Proposed CACLs for several CEMs, as well as nitrate-nitrogen and dissolved lead are presented in the CAP.

1.2 Document Organization

This Annual Report is organized as follows:

Section 2.0 provides a general introduction to this project and identifies the objectives of the Annual Report.

Section 3.0 summarizes new hydrogeologic investigation activities that were completed during 2005.

Section 4.0 presents a summary of water level and water quality monitoring data collected from the study area through 2005 including data from both the regional aquifer and perched ground water present in the northeast area of the EBCo site. Updated constituent trend and distribution maps, hydrographs and Mann-Kendall trend analyses are provided.

Section 5.0 provides a review of extraction system operations through 2005 including discharge history, water levels, concentration trends and solute recovery.

Section 6.0 summarizes GAC treatment system operations and performance during 2005.

Section 7.0 reviews UPDES Permit status for management of the extraction system discharges to surface waters

Section 8.0 provides a summary of Institutional Controls activities completed during 2005.

Section 9.0 offers recommendations for future ground water extraction and treatment system operations, performance monitoring and water quality monitoring.

Section 10.0 summarizes proposed changes to the ground water corrective action program for which written approval is required from DWQ. Such changes may include, but are not limited to, ground water recovery and treatment system operations, the ground water monitoring program, the institutional controls program and/or other actions related to ground water recovery, treatment and monitoring.

Section 11.0 is the list of references cited in the 2005 Annual Report.

2.0 INTRODUCTION

Concentrations of nitrate-nitrogen and several constituents of energetic materials (CEMs) have been detected in ground water in the area of The Ensign-Bickford Company (EBCo) facility in Spanish Fork, Utah. Figure 2-1 is a map of the project area illustrating the facility location and other geographic features of interest.

A phased hydrogeologic investigation, including soil borings, monitoring well installation and environmental sampling has been performed since 1986. Hydrogeologic data collection continues to the present day. These data and information were used to develop a conceptual model of the hydrogeologic system in the study area, which was presented in the CAP. The conceptual hydrogeologic model is regularly reviewed in light of the ongoing data collection efforts. No additional hydrogeologic investigation was performed during 2005 other than routine ground water sampling and analysis.

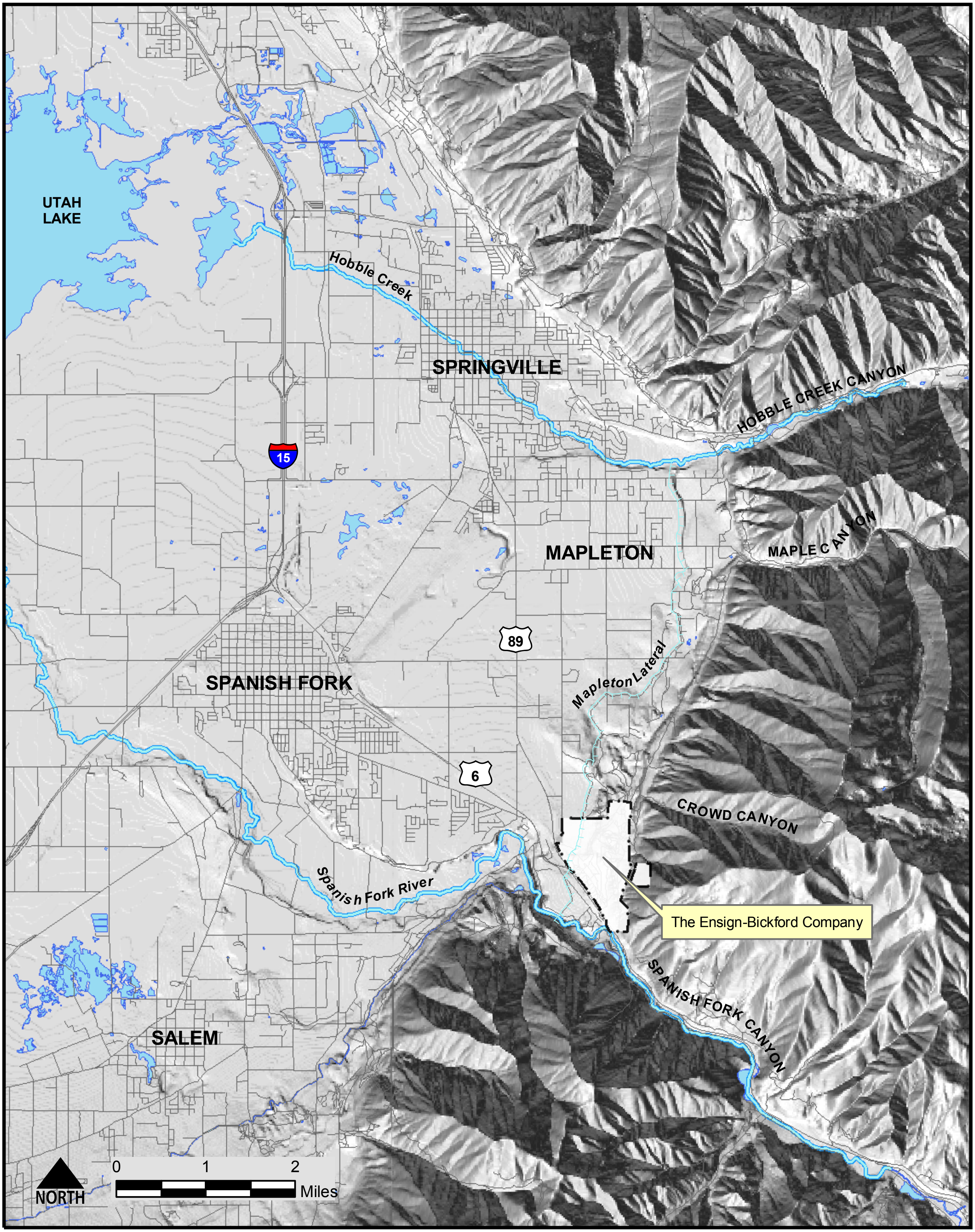
Corrective measures to address ground water quality conditions in the regional unconsolidated aquifer have been implemented as described in the CAP. A monitoring program has been developed to assess water quality conditions and ground water recovery and treatment system performance. An institutional controls program provides for mechanisms to present water quality data to private and municipal well owners and to identify and notify new well owners whose wells may be affected by nitrate and CEMs.

A RCRA Facility Investigation (RFI) is presently underway to evaluate conditions at the EBCo site. The primary purpose of the RFI is to identify and characterize potential impacts on site soils and ground water. Data collected during the RFI will be used to develop corrective measures that may be necessary to protect human health and the environment. An interim measure consisting of soil excavation and on-site thermal treatment of soils was begun in October 2005 and is presently underway to address some constituents of potential concern present in site soils.

2.1 Purpose and Objectives

The purpose of this document is to summarize hydrogeologic investigation activities, ongoing ground water quality monitoring data and ground water recovery and treatment system performance for calendar year 2005. Based upon these data and observations, recommendations are made for future hydrogeologic study, ongoing monitoring and operation of the ground water recovery and treatment system. This Annual Report fulfills these objectives by presenting the following:

- Ground water quality monitoring data and water level data collected from the regional unconsolidated aquifer and from perched ground water during 2005;
- Summary of ground water extraction well operations and performance including constituent concentration trends, water level trends and pumping history;



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SITE LOCATION MAP

FIGURE 2-1

- GAC treatment system monitoring data and a review of GAC treatment system operations;
- Report of institutional control activities; and,
- Recommendations for future data collection and ground water recovery and treatment system operations.

3.0 NEW HYDROGEOLOGIC INVESTIGATION ACTIVITIES

No additional monitoring wells were installed during 2005, nor were any new private or municipal wells added to the approved ground water monitoring program.

Due to soil excavation activities at the EBCo site, perched ground water monitoring well MW-15S was abandoned in September 2005. The pump was removed from the well and the well casing was pressure grouted with bentonite slurry. In addition the dry B-series monitoring wells B-6, B-7, B-8, B-10 and B-11 were also abandoned with bentonite slurry. Well abandonment forms were filed with the Utah Division of Water Rights.

A multi-day pump test of an irrigation well (the Booth well) located on undeveloped property in south Mapleton was performed in August of 2005. The pump test was designed to evaluate aquifer parameters in the vicinity of this well and to determine the potential long-term flow rate for this well. The primary purpose of these activities was to determine whether the Booth well is suitable for inclusion in EBCo's well network as a recovery well. If so, the Booth well could serve as a replacement for the nearby R-3 recovery well, which has exhibited diminished water yield in recent years. The results of this investigation were provided to DWQ in a document entitled *Booth Well Rehabilitation and Pump Test Report, Mapleton, Utah* (Charter Oak, 2005b).

4.0 GROUND WATER MONITORING PROGRAM

4.1 Regional Aquifer

4.1.1 Water Quality Data

Water quality data representing the four quarterly sampling events completed during 2005 are summarized in Tables 4-1 through 4-4. A summary table including nitrate and CEM data collected from the regional unconsolidated and bedrock aquifers throughout the ground water monitoring program is included as Appendix A. These tables include data collected from monitoring wells installed during the RFI and that are open to the regional unconsolidated aquifer.

Nitroglycerin, 2,4,6-TNT, 2,4-DNT and 2,6-DNT were not detected in any samples collected from the regional unconsolidated aquifer during 2005.

4.1.2 General Area of Solute Distribution

Figure 4-1 is a map of the study area that illustrates the approximate lateral extent of solute migration within the regional aquifer based on water quality data collected in the year 2005. The area of nitrate-nitrogen detections at or above 5 mg/L is outlined in light green and the area of RDX detections above the RDX method detection limit (MDL) is in blue. The MDL for RDX is 0.21 µg/L. The drinking water standard for nitrate-nitrogen is 10 mg/L. Water quality conditions within the regional aquifer vary, therefore certain wells located within the approximate area of impact may not have nitrate-nitrogen concentrations that are greater than 5 mg/L or RDX may not be present above the MDL. Ground water impacts have only been identified in the deep regional aquifer in the northern and western regions of the study area. Therefore, the limits of the affected area are inferred based on wells that are open to the deep regional aquifer in these locations (MW-3D, MW-13D, MW-14D, MW-30D, MW-31D, MW-32D, Seal, Mapleton No. 1, Westwood). Impacts have not been observed in the shallow regional aquifer in the northern and western regions of the study area as evidenced by samples collected from MW-5S, Osborne, Ballantyne, Friedman, Cobia, Baum, Leifson and Jensen even though several of these wells are located within the approximate lateral solute distribution boundaries illustrated in Figure 4-1.

Figure 4-1 shows that the affected region is elongated in a northerly direction along the mountain front. Concentrations of nitrate-nitrogen remained below 6 mg/L in the Westwood well during 2005 and CEMs have never been detected in this well. Nitrate-nitrogen concentrations remain above 5 mg/L at MW-14D. CEMs have not been detected in this well. The presence of elevated nitrate-nitrogen without CEMs at MW-

Table 4-1: First Quarter 2005 Regional Aquifer Water Quality Data Summary

Well ID	NO_3-N	HMX	RDX	EGDN	DEGDN	TEGDN	NG	TNT	BTTN	2,6-DNT	2,4-DNT	TMETN	PETN
MW-1S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-1D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-2S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-3D	**8.7**	<0.22	**7.38**	**0.82**	**1.22**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.60**	<0.32
MW-5S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-5D	**3.5**	<0.22	**3.24**	**0.55**	**0.55**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-6D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-7D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-8S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-8D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-9D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-10D	**13**	<0.22	**13.1**	**4.76**	**1.87**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**2.06**	**0.91**
MW-11D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-12D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-14D	**6.3**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-15D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-16D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-17D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-18D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-24D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-25D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-28D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-30D	**0.18**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-31D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-32D	**10**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
B-9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ballantyne	**0.040**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Osborne	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UP&L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Olsen	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Whiting	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Booth	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Frischknecht	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Young	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bluth	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Leifson	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Baum	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
New Haven	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Orton-23	**6.0**	**0.63**	**10.9**	**0.83**	**0.59**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**2.33**	<0.32
FW-1	**0.56**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
FW-2	**1.5**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Mapleton No. 1	**4.8**	<0.22	**3.05**	**0.76**	**0.56**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.54**	<0.32
Westwood	**5.1**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Carneseca	**0.44**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Seal	**0.92**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-1	**3.7**	**1.23**	**9.7**	<0.34	**1.075**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.99**	<0.32
R-2	**4.2**	<0.22	**0.45**	**3.58**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-3	**2.9**	**0.99**	**8.82**	<0.34	**0.99**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.71**	<0.32

Extraction well data collected March 2005.
Average concentrations are reported for those samples where blind duplicates were collected

NA = Not Analyzed NS = Not Sampled
Inorganic compounds reported in mg/L
CEM's reported in µg/L

Table 4-2: Second Quarter 2005 Regional Aquifer Water Quality Data Summary

Well ID	NO_3-N	HMX	RDX	EGDN	DEGDN	TEGDN	NG	TNT	BTTN	2,6-DNT	2,4-DNT	TMETN	PETN
MW-1S	**7.2**	**2.12**	**28.9**	**0.65**	**1.08**	**0.47**	<0.10	<0.16	**0.35**	<0.18	<0.16	**5.37**	**0.99**
MW-1D	**4.7**	**1.05**	**15.3**	**1.50**	**1.71**	**0.36**	<0.10	<0.16	<0.23	<0.18	<0.16	**2.69**	**0.63**
MW-2S	**3.0**	**1.68**	**6.21**	<0.34	**1.50**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.19**	<0.32
MW-3D	**8.6**	<0.22	**6.68**	**0.55**	**1.01**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.40**	<0.32
MW-5S	<0.010	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-5D	**3.5**	<0.22	**3.02**	**0.35**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-6D	**6.3**	**3.44**	**26.6**	<0.34	**1.21**	**0.39**	<0.10	<0.16	**0.95**	<0.18	<0.16	**5.92**	**0.93**
MW-7D	**3.0**	**1.49**	**5.85**	<0.34	**1.29**	**0.39**	<0.10	<0.16	<0.23	<0.18	<0.16	**0.76**	<0.32
MW-8S	**0.099**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-8D	**0.22**	**1.63**	**6.32**	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.81**	<0.32
MW-9D	**0.14**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-10D	**12**	<0.22	**12.3**	**4.07**	**1.75**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.24**	<0.32
MW-11D	**4.2**	**1.99**	**14.2**	<0.34	**1.13**	**0.53**	<0.10	<0.16	<0.23	<0.18	<0.16	**1.36**	<0.32
MW-12D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13D	**0.15**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-14D	**6.4**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-15D	**5.9**	**1.14**	**9.40**	<0.34	**0.69**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.68**	<0.32
MW-16D	**0.070**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-17D	<0.010	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-18D	**4.8**	<0.22	<0.21	**0.95**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-24D	**2.2**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-25D	<0.010	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-28D	**1.7**	**1.13**	**4.35**	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-30D	**0.11**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-31D	<0.010	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-32D	**9.5**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
B-9	**0.39**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Ballantyne	**0.048**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Osborne	**0.170**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UP&L	**4.9**	**1.66**	**16.4**	<0.34	**0.76**	**0.37**	<0.10	<0.16	<0.23	<0.18	<0.16	**2.09**	<0.32
Olsen	**4.8**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Whiting	**8.4**	**1.17**	**16.9**	**0.35**	**0.96**	<0.17	<0.10	<0.16	**0.35**	<0.18	<0.16	**4.69**	**0.59**
Booth	**4.9**	**1.85**	**22.3**	<0.34	**0.54**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**3.02**	**0.34**
Frischknecht	**2.2**	**0.73**	**8.53**	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.56**	<0.32
Young	**13**	**0.61**	**22.4**	**2.59**	**1.08**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**3.53**	**0.65**
Bluth	**7.3**	**0.24**	**5.09**	<0.34	**0.64**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.94**	<0.32
Leifson	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Baum	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
New Haven	<0.010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Orton-23	**7.5**	**0.82**	**10.9**	**0.67**	**0.67**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**2.07**	<0.32
FW-1	**0.12**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
FW-2	**0.50**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Mapleton No. 1	**4.7**	<0.22	**2.19**	**0.60**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.40**	<0.32
Westwood	**4.9**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Carneseca	**0.13**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Seal	**1.5**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-1	**4.1**	**1.51**	**9.4**	<0.34	**1.08**	**0.42**	<0.10	<0.16	<0.23	<0.18	<0.16	**1.01**	<0.32
R-2	**4.2**	<0.22	<0.21	**3.04**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-3	**2.9**	**1.02**	**6.93**	<0.34	**0.79**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**2.36**	<0.32

Extraction well data collected May 2005.
Average concentrations are reported for those samples where blind duplicates were collected

NA = Not Analyzed NS = Not Sampled
Inorganic compounds reported in mg/L
CEM's reported in µg/L

Table 4-3: Third Quarter 2005 Regional Aquifer Water Quality Data Summary

Well ID	NO_3-N	HMX	RDX	EGDN	DEGDN	TEGDN	NG	TNT	BTTN	2,6-DNT	2,4-DNT	TMETN	PETN
MW-1S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-1D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-2S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-3D	**8.3**	<0.22	**6.8**	**0.59**	**1.2**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.7**	<0.32
MW-5S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-5D	**3.3**	<0.22	**1.6**	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-6D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-7D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-8S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-8D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-9D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-10D	**12**	<0.22	**13**	**3.6**	**1.9**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.8**	**0.75**
MW-11D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-12D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-14D	**6.5**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-15D	**5.1**	**1.3**	**9.1**	<0.34	**0.60**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.65**	<0.32
MW-16D	**0.092**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-17D	<0.010	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-18D	**4.3**	<0.22	<0.21	**0.47**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-24D	**6.4**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-25D	**1.2**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-28D	**1.8**	**1.4**	**4.6**	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-30D	<0.010	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-31D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-32D	**7.1**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
B-9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ballantyne	**0.49**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Osborne	<0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UP&L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Olsen	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Whiting	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Booth	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Frischknecht	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Young	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bluth	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Leifson	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Baum	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
New Haven	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Orton-23	**8.3**	**0.91**	**12**	**1.1**	**0.86**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**3.2**	**0.73**
FW-1	**0.26**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
FW-2	**1.8**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Mapleton No. 1	**5.2**	<0.22	**2.55**	**0.78**	**0.60**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.44**	<0.32
Westwood	**5.7**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Carneseca	**0.14**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Seal	**0.54**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-1	**4.0**	**1.80**	**10.0**	**0.42 J**	**1.1**	**0.36 J**	<0.10	<0.16	<0.23	<0.18	<0.16	**0.86**	<0.32
R-2	**8.2**	<0.22	**1.5**	**4.30**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-3	**1.3**	**1.80**	**9.10**	**0.39 J**	**1.00**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**2.10**	<0.32

Extraction well data collected September 2005.
Average concentrations are reported for those samples where blind duplicates were collected

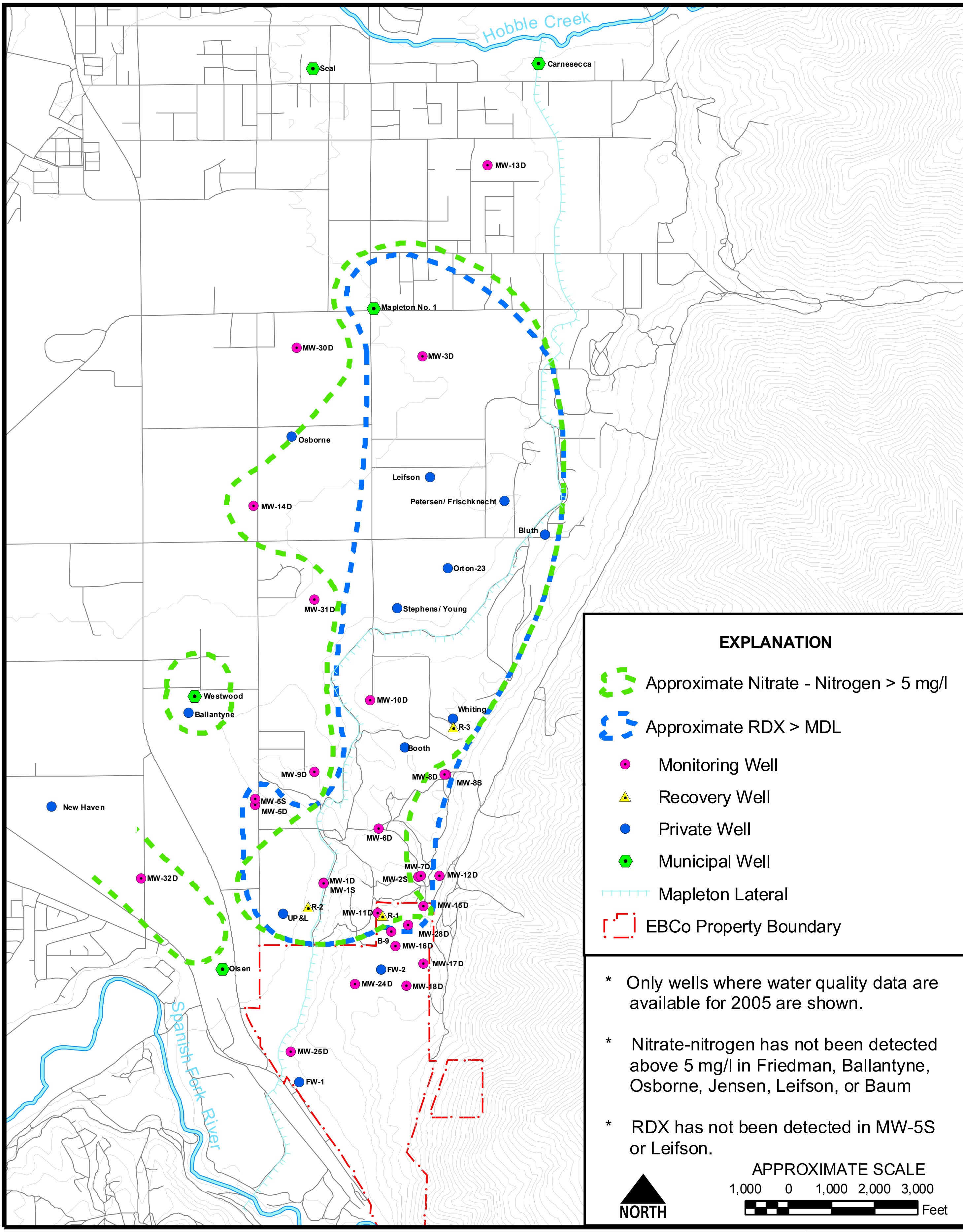
NA = Not Analyzed NS = Not Sampled
Inorganic compounds reported in mg/L
CEM's reported in µg/L

Table 4-4: Fourth Quarter 2005 Regional Aquifer Water Quality Data Summary

Well ID	NO_3-N	HMX	RDX	EGDN	DEGDN	TEGDN	NG	TNT	BTTN	2,6-DNT	2,4-DNT	TMETN	PETN
MW-1S	**7.0**	**2.3**	**26**	**0.42**	**0.88**	**0.49**	<0.10	<0.16	<0.23	<0.18	<0.16	**4.0**	**1.4**
MW-1D	**4.8**	**0.78**	**11**	**0.7**	**0.83**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.4**	<0.32
MW-2S	**1.5**	**1.6**	**5.8**	<0.34	**1.1**	**0.65**	<0.10	<0.16	<0.23	<0.18	<0.16	**0.70**	<0.32
MW-3D	**7.8**	<0.22	**7.2**	**0.96**	**1.2**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.3**	<0.32
MW-5S	<0.010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-5D	**3.1**	<0.22	**3.4**	**0.44**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-6D	**6.5**	**4.0**	**26**	<0.34	**0.78**	**0.44**	<0.10	<0.16	**1.1**	<0.18	<0.16	**4.8**	**1.1**
MW-7D	**1.2**	**1.7**	**6.2**	<0.34	**0.91**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.57**	<0.32
MW-8S	**0.045**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-8D	**0.077**	**2.1**	**7.2**	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.5**	<0.32
MW-9D	**0.058**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-10D	**11**	<0.22	**13**	**4.0**	**1.75**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.2**	**0.49**
MW-11D	**2.1**	**2.5**	**15**	<0.34	**1.05**	**0.48**	<0.10	<0.16	**0.53**	<0.18	<0.16	**1.5**	**0.42**
MW-12D	<0.010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13D	**0.29**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-14D	**5.9**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
MW-15D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-16D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-17D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-18D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-24D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-25D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-28D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-30D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-31D	**0.046**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-32D	**7.1**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
B-9	<0.010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ballantyne	**0.62**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Osborne	**0.29**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UP&L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Olsen	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Whiting	**1.6**	**1.1**	**8.1**	**0.36**	**0.81**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.5**	<0.32
Booth	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Frischknecht	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Young	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bluth	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Leifson	<0.010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Baum	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
New Haven	**0.29**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Orton-23	**7.6**	**0.78**	**11**	**0.78**	**0.49**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**2.5**	<0.32
FW-1	**0.26**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
FW-2	**0.51**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Mapleton No. 1	**0.48**	<0.22	**2.3**	**0.61**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**0.25**	<0.32
Westwood	**4.2**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Carneseca	**0.25**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
Seal	**0.37**	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-1	**0.32**	**1.5**	**9.3**	<0.34	**0.88**	**0.47**	<0.10	<0.16	<0.23	<0.18	<0.16	**0.60**	<0.32
R-2	**0.71**	<0.22	**1.5**	**4.1**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
R-3	**0.66**	**0.96**	**7.2**	**0.36**	**0.75**	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	**1.5**	<0.32

Extraction well data collected November 2005.
Average concentrations are reported for those samples where blind duplicates were collected

NA = Not Analyzed NS = Not Sampled
Inorganic compounds reported in mg/L
CEM's reported in µg/L



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NITRATE - NITROGEN AND RDX APPROXIMATE DISTRIBUTION MAP 2005

FIGURE 4-1

32D remains consistent with past data from the Olsen well. The Olsen well was sampled a single time in 2005 and the nitrate-nitrogen concentration was 4.8 mg/L.

4.1.3 Constituent Distribution and Trends

Distribution and trend maps are presented that illustrate the concentration trends and distribution of nitrate-nitrogen and selected CEMs present in the regional unconsolidated aquifer. Figures 4-2 through 4-11 are located in the map pockets at the end of this document. The color scheme of the individual bar charts indicates the relative location and depth of the wells. Dark purple indicates wells located on the topographic bench in the southeast side of the study area and that are generally within the foothills recharge area. Magenta represents the wells that are open to the shallow regional aquifer underlying the Mapleton Bench area or wells that have screen intervals at similar elevations. Light purple represents wells that are open to the deep regional aquifer that underlies the Mapleton Bench or wells that have screen intervals at similar elevations. Orange indicates wells that are open to the regional bedrock aquifer. Make note of the vertical scale of the charts as they vary for several of the compounds. The vertical scale for the trend charts on the Nitrate-nitrogen map is from 0 to 60 mg/L. The vertical scale for RDX and total specialty nitrate esters is from 0 to 60 μg/L and the vertical scale on the remainder of the maps is 0 to 16 μg/L.

Trend analyses in this report were performed on nitrate-nitrogen and CEM concentrations in water samples collected from monitoring wells and recovery wells. The Mann-Kendall test method was used in the trend analyses. The Mann-Kendall test method is a non-parametric test and is performed using a formula listed in Appendix B of Gilbert (1987). As mentioned in Gilbert (p.202, 1987), at least ten data points are needed for application of the Mann-Kendall test. In Mann-Kendall analyses, the hypothesis of no trend against the alternative hypothesis of either a downward trend or an upward trend (two-sided test) is tested at a significance level of $\alpha = 0.05$. In order to reject the hypothesis of no trend at $\alpha = 0.05$ for a two-sided test, the absolute value of the Z statistic calculated by the Mann-Kendall method must be greater than or equal to 1.960. By using a significance level of $\alpha = 0.05$, there will be a five percent chance of rejecting the hypothesis of no trend when it is true. In other words, the statistical confidence of the reported trend is 95%.

The ensuing discussions regarding concentrations trends reflect the results of the Mann-Kendall trend analyses. Mann-Kendall trend analyses results for these data are provided in Appendix B. Details regarding the possible sources of solutes to ground water and the environmental fate of these compounds are presented in the CAP and are not repeated herein. Furthermore, these trend and distribution maps were discussed extensively in the CAP, therefore the ensuing presentation uses the CAP as a foundation and focuses on new data and/or changes in trends or distribution. Please note that the trend analyses were performed using the full data set included in Appendix A; however, for presentation purposes, the trend maps present data on a quarterly basis.

4.1.3.1 Nitrate-Nitrogen

Figure 4-2 illustrates the distribution and concentration trends for nitrate-nitrogen from selected wells from 1989 until the fourth quarter of 2005. Several observations can be made upon review of the nitrate-nitrogen distribution and trend map.

- With the exception of Evans/Young and MW-10D, nitrate-nitrogen concentrations in regional aquifer wells monitored throughout the study area were below the 10 mg/L MCL during 2005. In contrast to the 2004 Annual Report, nitrate-nitrogen concentrations in MW-32D were equal to or below 10 mg/L during 2005.

- Downward trends in nitrate-nitrogen concentrations continue to be observed in wells in the southern part of the study area located close to the EBCo site and within or proximal to the Crowd Canyon alluvium. Nitrate-nitrogen concentrations in wells in the southern part of the study area and proximal to the EBCo site remain below 10 mg/L. The nitrate-nitrogen concentrations in many of the wells in this area continue to be asymptotic.

- Nitrate-nitrogen concentrations in the Olsen well exhibit a downward trend and remain below 10 mg/L. Nitrate-nitrogen concentrations in monitoring well MW-32D, located northwest and presumably down gradient of the Olsen well, also exhibits a downward trend with a range from 7.1to 10 mg/L during 2005.

- Based on the Mann-Kendall test, nitrate-nitrogen concentrations at MW-10D and MW-14D continue to exhibit upward trends. Wells further to the north (i.e. Frischknecht, Young, MW-3D, and Mapleton No. 1) generally have either no trends or downward trends.

- An upward trend in nitrate-nitrogen concentrations continues to be observed at EBCo facility well FW-2. The nitrate-nitrogen concentration in FW-2 did not exceed 1.8 mg/L in 2005.

- The Ballantyne, Osborne Leifson and MW-5S wells, open to the shallow regional aquifer, continue to exhibit low nitrate-nitrogen concentrations (<0.01 to 1 mg/L).

- In the northern part of the study area, nitrate-nitrogen concentrations at Seal, Carneseca and MW-13D have remained consistently low (1.5 mg/L or less during 2005).

- The nitrate-nitrogen concentration in MW-12D, open to the bedrock aquifer, was below the method detection limits (0.01 mg/L) during 2005.

- Nitrate-nitrogen concentrations in on-site monitoring wells open the regional aquifer remain below 10 mg/L. With the exception of an increasing nitrate concentration trend in MW-24D, the remaining on-site regional aquifer monitoring wells exhibit no or declining trends. The nitrate-nitrogen concentration in MW-24D did not exceed 6.4 mg/L during 2005.

4.1.3.2 RDX

RDX data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-3. Several observations can be made upon review of the RDX distribution and trend map.

- During 2005, RDX concentrations are below the interim ground water quality goal of 2 μg/L at twenty-two of the forty-three wells where CEMs were analyzed as part of the regional aquifer ground water monitoring program.

- Downward trends in RDX concentrations continue to be observed in wells open to the regional aquifer in the area of the Crowd Canyon alluvium. Downward trends in RDX concentrations are also present at the locations of MW-1S, MW-1D and UP&L. An increasing RDX concentration trend is observed at R-2, although RDX concentrations remain below 2 μg/L.

- RDX has not been detected in the Olsen well or MW-32D. The lack of RDX (and other CEMs) is consistent with the historic use of SWMU 26, where RDX and specialty nitrates were not used.

- Upward RDX concentration trends continue at MW-3D and MW-10D. No trend is observed at Evans/Young suggesting a decrease in RDX concentrations since 2003 when an upward trend was last observed at this location. A downward trend is observed at Frischknecht for the first time. Mapleton No. 1 continues to exhibit no trend. RDX concentrations in Mapleton No. 1 have remained relatively low (<3 μg/L during 2005).

- RDX concentrations in MW-5D continue to show an upward trend, although concentrations remain low during 2005(<3.5 μg/L).

- In contrast to the CAP in which a downward trend was reported, RDX concentrations at the Whiting (Joyner) well continue to exhibit no trend with the addition of data through 2005. A downward trend is present at R-3.

- RDX is not present in monitoring wells MW-14D, MW-30D, MW-31D, and MW-32D.

- During 2005, RDX and other CEMs were not detected in MW-5S which is open to the shallow regional aquifer. In previous years, neither RDX nor any other

CEMs were detected in several other wells open to the shallow regional aquifer including Osborne, Ballantyne, Jensen, Liefson, and Baum. This is consistent with very low or non-detectable levels of nitrate-nitrogen in these shallow regional aquifer wells.

- RDX has only been detected in three of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D, MW-15D and MW-28D). Downward RDX concentration trends are observed at these three wells.

4.1.3.3 HMX

HMX data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-4. Several observations can be made upon review of the HMX distribution and trend map.

- Based upon the available water quality data, HMX concentrations have been and remain well below the proposed CACL of 400 μg/L (Health Advisory).

- The overall distribution of HMX is more limited than that of nitrate, RDX and several of the specialty nitrate compounds.

- No upward trends in HMX concentrations are observed in any wells open to the regional unconsolidated aquifer.

- Downward trends in HMX concentrations are observed at MW-1S, MW-2S, MW-6D, MW-7D, MW-8S, MW-8D, MW-11D, UP&L, R-1 and R-3.

- No trend in HMX concentrations were observed at the Whiting, Evans/Young and Orton-23 wells during 2005.

- In the north central part of the study area HMX has not been detected at MW-3D and Mapleton No. 1. Only very low concentrations (<1.0 μg/L) were detected in other wells in this general area (Frischknecht, Evans/Young and Bluth) during 2005. HMX was detected once in MW-10D during 2002 (0.3 μg/L) and has not been detected since.

- HMX has not been detected in monitoring wells MW-14D, MW-30D, MW-31D and MW-32D.

- HMX has only been detected in three of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D, MW-15D and MW-28D). HMX concentrations in MW-11D exhibit a downward trend where no trend is present at MW-15D or MW-28D.

4.1.3.4 2,4,6-TNT

The compound 2,4,6-TNT was not detected in wells open to the regional unconsolidated aquifer during 2005.

4.1.3.5 2,4-DNT and 2,6-DNT

The compounds 2,4-DNT and 2,6-DNT were not detected in wells open to the regional unconsolidated aquifer during 2005.

4.1.3.6 Nitroglycerin

Nitroglycerin (NG) was not detected in wells open to the regional unconsolidated aquifer during 2005.

4.1.3.7 EGDN

EGDN data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-5. Several observations can be made upon review of the EGDN distribution and trend map.

- EGDN concentrations have never exceeded the proposed CACL of 52 μg/L at any of the monitoring wells and are not expected to do so in the future.

- EGDN has not been detected in monitoring wells MW-14D, MW-30D, MW-31D and MW-32D.

- Downward trends in EGDN concentrations are present in MW-1S, MW-2S, MW-3D, MW-6D, MW-7D, MW-8S, MW-10D, MW-11D, Evans/Young, UP&L, Mapleton No. 1, Orton-23, R-1, R-2, and R-3.

- In contrast with the 2003 Annual Report an upward trend in EGDN concentration is present at FW-2. Low concentrations of EGDN (<0.60 μg/L) were reported as detected in FW-2 during four quarterly sampling events during 2004, whereas no EGDN was detected previously, nor was any detected during 2005. With the addition of the 2005 data, an upward trend is also observed in the Whiting well where no trend was observed previously.

- Sporadic low detections of EGDN along the eastern boundary of the study area differ from the distribution observed for RDX and other specialty nitrate compounds (DEGDN and TMETN).

- EGDN has only been detected in three of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D, MW-15D and MW-18D). A downward trend is present at MW-11D. In contrast to the 2004 Annual Report, there is no trend at MW-18D where an upward trend was present previously. An upward trend is present at MW-18D and no trend is present at MW-15D. EGDN was not detected in MW-15D during 2004 or 2005.

4.1.3.8 DEGDN

DEGDN data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-6. Several observations can be made upon review of the DEGDN distribution and trend map.

- DEGDN concentrations have never exceeded the proposed CACL of 52 µg/L at any of the monitoring wells and are not expected to do so in the future.

- DEGDN has not been detected in monitoring wells MW-14D, MW-30D, MW-31D and MW-32D.

- Downward trends in DEGDN concentrations are evident in wells open to or in close proximity to the Crowd Canyon alluvium including, MW-1S, MW-1D, MW-2S, MW-6D, MW-7D, MW-8D and MW-11D. Downward trends are also present at MW-3D, Whiting, UP&L, Evans/Young, Frischknecht, Orton-23, R-1 and R-3.

- DEGDN has only been detected in four of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D, MW-15D, MW-18D and MW-28D). Downward trends are present at MW-11D and MW-28D and no trends are present at MW-18D and MW-15D. Previously MW-28D had no trend and MW-18D had an upward trend.

4.1.3.9 TEGDN

TEGDN data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-7. Several observations can be made upon review of the TEGDN distribution and trend map.

- Based on the available data, TEGDN concentrations have never exceeded the proposed CACL of 52 µg/L at any of the monitoring wells and are not expected to do so in the future.

- TEGDN is not widely distributed and concentrations are generally lower than most other CEMs.

- Consistent with the 2004 Annual Report, an upward trend in TEGDN concentrations are observed at MW-1D. No trend is present at Whiting where an upward trend was present previously

- A downward trend continues to be observed at present at MW-8S. An downward trend is also present at MW-7D where no trend was present previously.

- There are no trends, either upward or downward, at any of the other monitoring locations.

- Detections at wells that are distal from the EBCo site continue to be sporadic and low.

- TEGDN has not been detected in MW-3D, MW-5D, MW-10D, MW-14D, MW-30D, MW-31D, MW-32D, Bluth and Mapleton No. 1.

- TEGDN has only been detected in three of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D, MW-15D and MW-28D). No trends are present in these wells nor was TEGDN detected in MW-15D and MW-28D during 2005.

4.1.3.10 TMETN

TMETN data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-8. Several observations can be made upon review of the TMETN distribution and trend map.

- Based on the available data, TMETN concentrations have never exceeded the proposed CACL of 52 μg/L at any of the monitoring wells and are not expected to do so in the future.

- Downward trends in TMETN concentrations are observed in MW-1S, MW-1D, MW-8D, MW-11D, UP&L, Whiting, Booth, Frischknecht, Orton-23, R-1 and R-3.

- Consistent with the 2004 Annual Report, upward trends in TMETN concentrations are only observed in MW-3D, MW-10D and Mapleton No. 1.

- No trends are observed at other wells where TEGDN has been detected.

- TMETN first appeared in MW-10D in 1998 and did not appear in the Mapleton No. 1 well until late 1999. TMETN has been detected consistently in both these wells since the first detections

- TMETN has not been detected in monitoring wells MW-14D, MW-30D, MW-31D and MW-32D.

- TMETN has been detected in only three of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D, MW-15D and MW-28D). No trend is observed at MW-15D and downward trends are observed at MW-11D and MW-28D. TMETN was not detected in MW-15D or MW-28D during 2005.

4.1.3.11 BTTN

BTTN data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-9. Several observations can be made upon review of the BTTN distribution and trend map.

- Based on the available data, BTTN concentrations have never exceeded the proposed CACL of 52 μg/L at any of the monitoring wells and are not expected to do so in the future.

- Similar to TEGDN, BTTN is not widely distributed and concentrations are generally lower than most other CEMs.

- The only upward trends in BTTN concentrations continue to be observed at MW-6D and Frischknecht. With the addition of 2005 data, no trend is present at Whiting where an upward trend was previously observed. Downward trends in BTTN concentrations are observed MW-8D, Booth and R-1, otherwise there are no trends, either upward or downward, at the other sixteen monitoring locations where BTTN has been detected.

- Detections at wells that are distal from the EBCo site are sporadic and low.

- BTTN has not been detected in MW-3D, MW-5D, MW-10D, MW-14D, MW-30D, MW-31D, MW-32D, Bluth and Mapleton No. 1.

- BTTN has only been detected in one of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D).

4.1.3.12 PETN

PETN data from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-10. Several observations can be made upon review of the PETN distribution and trend map.

- Based on the available data, PETN concentrations have never exceeded the proposed CACL of 52 μg/L at any of the monitoring wells and are not expected to do so in the future.

- The highest PETN concentrations are generally detected within and adjacent to the Crowd Canyon alluvium. This is close to the northeast corner of the Plant where PETN was manufactured.

- Consistent with the 2004 Annual Report, the only upward PETN concentration trend is observed at MW-10D.

- Downward trends in PETN concentration continue to be observed at the MW-1S, MW-6D, MW-8D, MW-11D, UP&L, Bluth, Orton-23, R-1 and R-3. No trends are present at the other wells where PETN has been detected.

- Detections at wells that are distal from the source area are sporadic and low.

- PETN was not detected in MW-3D until 1998, MW-10D until 1999 and Mapleton No. 1 until 2000. PETN was detected in MW-10D during 2005; however, PETN was not detected in MW-3D or Mapleton No. 1 during 2005. PETN was detected a single time at MW-5D during 2002. This is the only detection of PETN at MW-5D.

- PETN has not been detected in monitoring wells MW-14D, MW-30D, MW-31D and MW-32D.

- PETN was not detected in eight of the nine on-site monitoring wells that are open to the regional aquifer during 2005. The only detection was in MW-11D. PETN was detected at a concentration of 0.38 μg/L a single time in MW-15D during 2002.

4.1.3.13 Total Specialty Nitrate Esters

As noted in the CAP, the specialty nitrate esters (EGDN, DEGDN, TEGDN, TMETN, BTTN, PETN) have similar health effects. Although the compound NG is included within this category, NG has not been detected in the regional aquifer and is not part of this discussion. The proposed CACL for any single compound is the same as for the combined compounds. For this reason a distribution and trend map has been prepared for the combined specialty nitrate esters. Total specialty nitrate esters (TSNE) concentrations from the third quarter of 1995 through the fourth quarter 2005 are presented in Figure 4-11. Several observations can be made upon review of the TSNE distribution and trend map.

- The concentrations of combined specialty nitrate esters do not exceed the proposed CACL of 52 μg/L at any monitoring location and, concentrations of combined specialty nitrate esters are not expected to exceed the proposed CACL at any time in the future.

- As would be expected based on the distribution and trends of the individual compounds, the highest concentrations were present in wells close to the northeast corner of the site.

- Downward trends in TSNE concentrations are observed at MW-1S, MW-2S, MW-3D, MW-6D, MW-7D, MW-8S, MW-8D, MW-11D, UP&L, Whiting, Booth, Frischknecht, Evans/Young, Orton-23, Mapleton No. 1, R-1, R-2 and R-3.

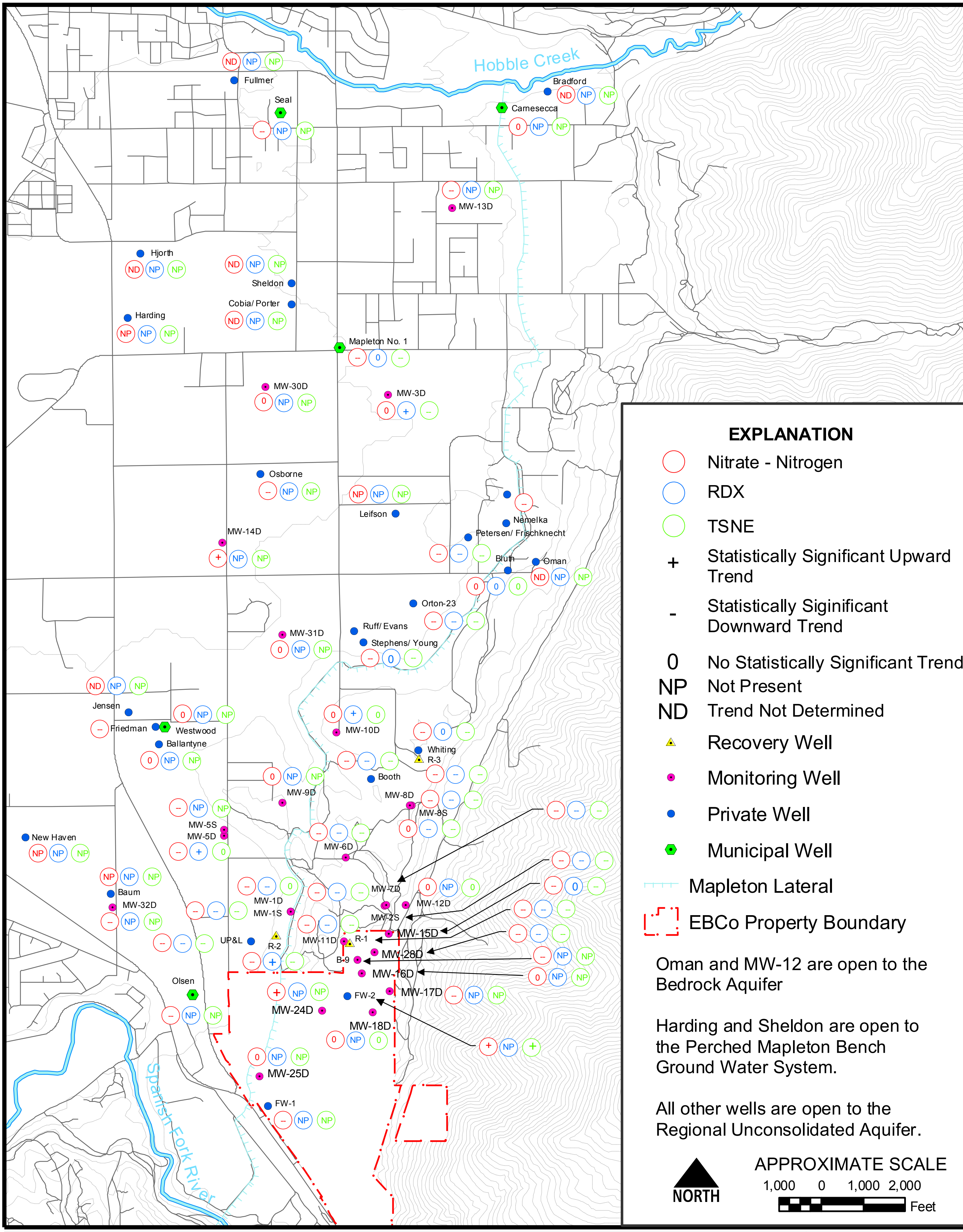
- Facility well FW-2 exhibits an upward trend in TSNE concentrations, reflecting detections of low concentrations of EGDN in this well during 2004, whereas no EGDN was detected prior to 2004. No CEMs were detected in FW-2 during 2005.

- No trends are present in other wells where specialty nitrates have been detected.

- Specialty nitrate compounds have been detected in four of the nine on-site monitoring wells that are open to the regional aquifer (MW-11D, MW-15D, MW-18D and MW-28D). The downward trend observed in MW-11S is consistent with the 2004 Annual Report. Downward trends in TSNE concentrations are present at MW-15D and MW-28D where there were no trends prior to the addition of 2005 data. No trend is present at MW-18D, where an upward trend was previously observed.

4.1.4 Solute Concentrations Trends

Figure 4-12 characterizes concentration trends of selected COCs at several monitoring locations in the study area. The symbols at each monitoring location are indicative of concentrations trends at these locations. The statistical analyses of concentration trends were performed using the Mann-Kendall technique described in the previous section. Data used for this analysis are provided in Appendix B. A (+) symbol indicates a statistically significant upward concentration trend. A (-) symbol indicates a statistically significant downward concentration trend. A (o) symbol indicates that there is no statistically significant trend. A (ND) symbol indicates that the statistical significance of a potential trend could not be determined from the available data. An (NP) symbol indicates that the compound is not present in the selected observation well. Samples from the Baum, Osborne, New Haven, Liefson, Bradford, Cobia, Hjorth, Fullmer, Ballantyne, Jensen, Harding, Sheldon and Oman wells have been analyzed for CEMs at least once, without detections. The Harding and Sheldon wells are open to the perched Mapleton Bench ground water system and Oman is open to the bedrock aquifer. All other wells depicted are open to the regional unconsolidated aquifer. RDX, TSNE and nitrate-nitrogen have been selected to illustrate these trends. The symbols representing RDX trends are blue, TSNE are green and nitrate-nitrogen are magenta.



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CONCENTRATION TRENDS EVALUATED USING THE MANN-KENDALL TEST

FIGURE 4-12

4.1.4.1 Nitrate-Nitrogen Trends

Downward trends in nitrate-nitrogen concentration are observed in nearly all wells located proximal to the EBCo site. Based on the available data, the only upward trends in nitrate-nitrogen concentrations are present at MW-14D, MW-24D and FW-2. Nitrate-nitrogen concentrations in several wells located in the approximate middle of the affected area (i.e. Orton-23, Evans/Young, and Frischknecht) have downward trends. With the exception of MW-14D, no upward trends in nitrate-nitrogen concentrations are observed in wells located at or close to the margins of the affected area (i.e. Olsen, MW-5D, Westwood, MW-30D, MW-32D Mapleton No. 1).

The trends in nitrate-nitrogen concentration data indicate that concentrations continue to decline at most locations within the affected area. Upward nitrate-nitrogen concentration trends at MW-14D will be evaluated through ongoing monitoring.

4.1.4.2 RDX Trends

Downward trends in RDX concentration are observed in nearly all wells located proximal to the EBCo site where it has been detected. The only upward trend in RDX concentration in this area is observed at recovery well R-2, reflecting the appearance of RDX in 2003 and continuing through 2005. Monitoring well MW-15D is the only monitoring wells in this general area where there is no trend. RDX concentrations in MW-10D, located in the approximate middle of the affected area, exhibit an upward trend as does MW-3D located further to the north. Bluth and Evans/Young exhibit no RDX concentration trend whereas other wells in this general area (Booth, Frischknecht and Orton-23) exhibit downward trends. With the exception of MW-5D, RDX is either not present or there are no upward trends in RDX concentrations in wells located at or close to the margins of the affected area (i.e. Olsen, Westwood, MW-14D, Mapleton No. 1, MW-30D, MW-31D and MW-32D). RDX concentrations in MW-5D exhibit an upward trend, but remained below 4 μg/L during 2005. As noted in the 2004 Annual Report, RDX was reported at a concentration of 4.2 μg/L in MW-30D during the fourth quarter 2003 sampling event; however, RDX has not been detected in subsequent samples and it is considered to not be present at this location.

The trends in RDX concentration data indicate that concentrations are declining close to the EBCo site. With the exception of MW-5D, RDX is either not present or there are no trends in wells along the outer margin of the affected area. Increasing trends at MW-3D and MW-10D in the approximate middle of the affected area will be evaluated through continued ground water monitoring.

4.1.4.3 TSNE Trends

Downward trends in TSNE concentration are observed in nearly all wells located proximal to the EBCo site. MW-1D is the only well in this area where there is no trend.

The only upward trend is calculated for facility well FW-2, reflecting detections of <1 μg/L of EGDN in this well during 2004. There were no detections of EGDN at FW-2 during 2005. Downward TSNE concentration trends are observed in wells located in the approximate middle of the affected area (i.e. MW-3D, Booth, Frischknecht, Evans/Young). Specialty nitrate esters are either not present or there are no upward trends in TSNE concentrations in wells at or close to the margins of the affected area (i.e. Olsen, Westwood, MW-5D, MW-14D, Mapleton No. 1, MW-30D, MW-31D, MW-32D).

The trends in TSNE concentration data indicate that concentrations are generally declining close to the EBCo site and throughout the study area. TNSE are either not present or there are no trends in wells along the outer margin of the affected area.

4.1.5 General Water Chemistry

No new general water chemistry data for the regional aquifer were collected during 2005. The latest Piper diagram of general water chemistry data for the regional aquifer can be found in the 2003 Annual Report (Charter Oak, 2004).

4.1.6 Regional Aquifer Water Level Data

Figure 4-13, presents hydrographs for selected monitoring wells and privately owned wells open to the regional aquifer where water level data are available. Water level data are currently collected at a bimonthly frequency. Hydrographs for wells grouped in the northeast area of the EBCo site are presented in the area of enlargement located in the lower right corner of Figure 4-13. Recovery wells are not included as they are addressed in Section 5.0 of this Annual Report. The horizontal axis (X) of each hydrograph represents time and runs from January 1991 through December 2005. The vertical axis (Y) is the water level elevation and covers a range of seventy-feet in each hydrograph. The upper and lower values of the water level elevation range may vary between hydrographs. Water level elevation data used to develop these hydrographs are presented in Appendix C.

During 2005, water levels in most monitoring locations throughout the study appear to have leveled off, if not increased, continuing a trend observed during 2004. The reason for this change in water level behavior is probably related to a combination of factors including a return to average or above average precipitation after two extreme drought years in 2001 and 2002 and general water conservation efforts implemented by local municipalities. The fluctuations in water levels from 2000 through 2005 in MW-5S, MW-5D, MW-3D, MW-13D, MW-14D, MW-30D, MW-31D and MW-32D probably reflect the seasonal pumping of high volume municipal wells. Some of the more rapid water level changes observed in certain wells since 1998 reflect the stopping and starting of nearby extraction wells or in the cases of Bluth, Young and Whiting the use of those wells for seasonal irrigation.

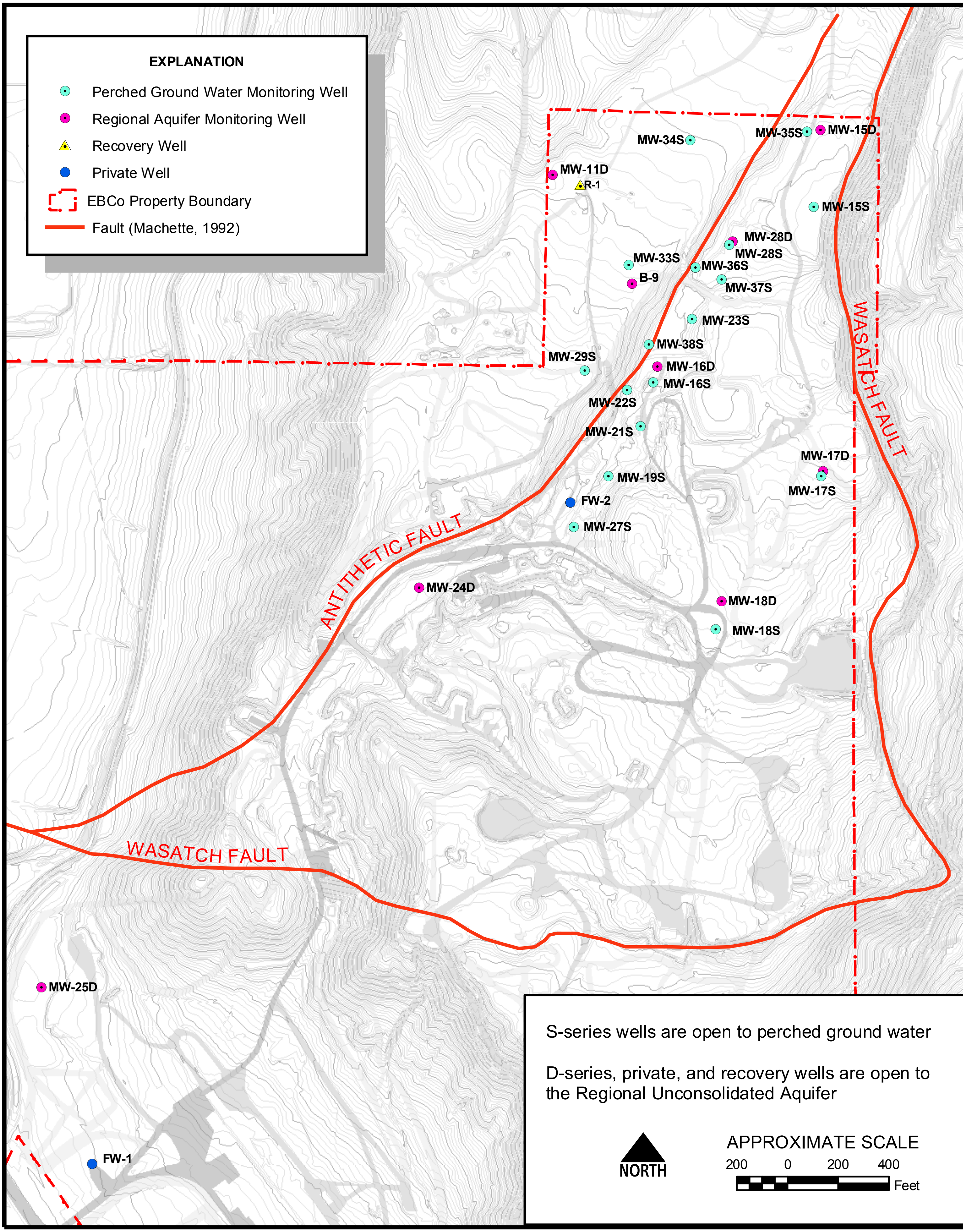
4.2 On-site Perched Ground Water Monitoring

4.2.1 Water Quality Data

Figure 4-14 illustrates the location of monitoring wells open to perched ground water along with proximal wells open to the regional unconsolidated aquifer. Tables 4-5 through 4-8 present quarterly water quality data collected during 2005 from the perched ground water monitoring wells. In addition to nitrate-nitrogen and CEMs, sulfate is monitored in perched ground water because its presence may be related to the use of sulfuric acid in the formulation of NG/EGDN.

Perched ground water data continue to show substantial spatial variability. CEM constituents and concentrations vary considerably from location to location. Generally, higher concentrations of nitrate-nitrogen and CEMs in perched ground water are found close to historic manufacturing locations or along former wastewater conveyance structures. Lower concentrations or non-detections are generally found in monitoring wells located on the eastern side of the graben and outside of the graben to the west. Figures 4-15 through 4-27 present concentration versus time plots of nitrate-nitrogen, sulfate and detected CEMs for monitoring wells open to perched ground water. Please be advised that due to the wide variability in constituent concentrations, these plots could not be prepared using equal scales – this should be taken into account when reviewing these plots. The Mann-Kendall test method was used to determine concentration trends for the monitoring wells for which there is sufficient data. The concentration trend analyses results for these data are presented in Appendix B. Sufficient data from more recently constructed monitoring wells are not yet available to statistically assess trends using the Mann-Kendall test. Specifically, trends could not be statistically evaluated for monitoring wells MW-33S through MW-38S; however, these plots are useful for illustrating well-to-well variability in constituent concentration and temporal variations in concentration.

As illustrated in Figure 4-15, nitrate-nitrogen has been detected in all perched ground water monitoring wells. In 2005, nitrate-nitrogen concentrations in perched ground water ranged from <1 mg/L to 1300 mg/L with the highest concentrations found at MW-16S, MW-23S, MW-28S and MW-37S. Based upon prior and subsequent data, it is probable that the low concentrations reported in monitoring wells MW-16S and MW-23S during the fourth quarter 2004 sampling event are erroneous even though no obvious problems were identified during a thorough review of the laboratory report. Statistically significant downward trends in nitrate-nitrogen concentrations are present at MW-15S, MW-17S, MW-22S, MW-23S, MW-28S and MW-29S; otherwise no statistically significant nitrate-nitrogen trends (upwards or downwards) are present in the other monitoring wells open to perched ground water. Nitrate-nitrogen concentrations have increased slightly in each sampling event in MW-34S, representing a probable increasing trend; however concentrations remain below 4 mg/L. The presence and distribution of nitrate-nitrogen in perched ground water within the graben is consistent with historic manufacturing operations in this area.



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PERCHED GROUND WATER MONITORING WELL LOCATIONS

FIGURE 4-14

Table 4-5: First Quarter 2005 Perched Ground Water Analytical Data Summary

Analyte (units)	RFI Monitoring Well																
	MW-15S	**MW-16S**	**MW-17S**	**MW-18S**	**MW-19S**	**MW-21S**	**MW-22S**	**MW-23S**	**MW-27S**	**MW-28S**	**MW-29S**	**MW-33S**	**MW-34S**	**MW-35S**	**MW-36S**	**MW-37S**	**MW-38S**
Anions (mg/L)																	
Nitrate/nitrite-nitrogen	NS	**570**	NS	NS	NS	NS	NS	**340**	NS	**110**	NS	NS	NS	NS	**35**	**580**	**0.14**
Sulfate	NS	**1100**	NS	NS	NS	NS	NS	**1100**	NS	**520**	NS	NS	NS	NS	**1200**	**2500**	**420**
CEMs (µg/L)																	
HMX	NS	**32.8**	NS	NS	NS	NS	NS	<0.26	NS	**24.5**	NS	NS	NS	NS	<0.26	<0.26	<0.26
RDX	NS	**756**	NS	NS	NS	NS	NS	**91.1**	NS	**386**	NS	NS	NS	NS	<0.26	<0.26	<0.26
EGDN	NS	**35.2**	NS	NS	NS	NS	NS	<0.52	NS	<0.52	NS	NS	NS	NS	<0.52	<0.52	<0.52
DEGDN	NS	**108**	NS	NS	NS	NS	NS	<0.52	NS	**4.16**	NS	NS	NS	NS	<0.52	<0.52	<0.52
TEGDN	NS	**189**	NS	NS	NS	NS	NS	<0.52	NS	**2.09**	NS	NS	NS	NS	<0.52	<0.52	<0.52
NG	NS	**245**	NS	NS	NS	NS	NS	<0.52	NS	**0.27 J**	NS	NS	NS	NS	<0.52	<0.52	<0.52
2,4,6-TNT	NS	<0.26	NS	NS	NS	NS	NS	<0.26	NS	<0.26	NS	NS	NS	NS	<0.26	<0.26	<0.26
BTTN	NS	**3.37**	NS	NS	NS	NS	NS	<0.52	NS	<0.52	NS	NS	NS	NS	<0.52	<0.52	<0.52
2,6-DNT	NS	**0.39**	NS	NS	NS	NS	NS	<0.26	NS	<0.26	NS	NS	NS	NS	<0.26	<0.26	<0.26
2,4-DNT	NS	<0.26	NS	NS	NS	NS	NS	<0.26	NS	<0.26	NS	NS	NS	NS	<0.26	<0.26	<0.26
TMETN	NS	**31.7**	NS	NS	NS	NS	NS	<0.52	NS	**29.8**	NS	NS	NS	NS	<0.52	<0.52	<0.52
PETN	NS	**20.9**	NS	NS	NS	NS	NS	<0.52	NS	**13.1**	NS	NS	NS	NS	<0.52	<0.52	<0.52

In those instances where a duplicate sample was analyzed, the average concentration is provided
(MW-28S & blind duplicate MW-82S).
"S" series wells are open to perched ground water.
All samples collected from dedicated bladder pumps using low flow/ low volume sampling methods

NS Not sampled
J Data are estimated. Reported value is less than the PQL but greater than the MDL.

Table 4-6: Second Quarter 2005 Perched Ground Water Analytical Data Summary

Analyte (units)	RFI Monitoring Well																
	MW-15S	MW-16S	MW-17S	MW-18S	MW-19S	MW-21S	MW-22S	MW-23S	MW-27S	MW-28S	MW-29S	MW-33S	MW-34S	MW-35S	MW-36S	MW-37S	MW-38S
Anions (mg/L)																	
Nitrate/nitrite-nitrogen	**0.99**	**810**	**1.30**	**0.12**	**21**	NS	**31**	**430**	**11**	**130**	**3.2**	**2.9**	**2.8**	**0.024**	**67**	**1300**	**0.25**
Sulfate	**25**	**770**	**29**	**110**	**330**	NS	**310**	**960**	**110**	**450**	**310**	**750**	**22**	**75**	**1300**	**1600**	**390**
CEMs (µg/L)																	
HMX	<0.26	**28.9**	<0.26	<0.26	<0.26	NS	<0.26	<0.26	<0.26	**21.6**	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
RDX	**0.59**	**744**	**0.45**	<0.26	**1.44**	NS	<0.21	**86.7**	**9.7**	**320**	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
EGDN	<0.52	**28.6**	<0.52	<0.52	**455**	NS	**16.7**	<0.52	**329**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
DEGDN	<0.52	**68.1**	<0.52	<0.52	**7500**	NS	**1.22**	<0.52	**3130**	**3.43**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
TEGDN	<0.52	**146**	<0.52	<0.52	**1590**	NS	**0.66**	<0.52	**319**	**1.81**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
NG	<0.52	**200**	<0.52	<0.52	**1.63**	NS	<0.52	<0.52	**3.93**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
2,4,6-TNT	<0.26	<0.26	<0.26	<0.26	<0.26	NS	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
BTTN	<0.52	**3.00**	<0.52	<0.52	**6.19**	NS	<0.52	<0.52	**73.3**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
2,6-DNT	<0.26	**0.53**	<0.26	<0.26	**1.23**	NS	<0.26	<0.26	**0.49**	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
2,4-DNT	<0.26	<0.26	<0.26	<0.26	<0.26	NS	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
TMETN	<0.52	**37.6**	<0.52	<0.52	**188**	NS	<0.52	<0.52	**513**	**28.6**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
PETN	<0.52	**21.8**	<0.52	<0.52	<0.52	NS	<0.52	<0.52	<0.52	**11.6**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52

In those instances where a duplicate sample was analyzed, the average concentration is provided
(MW-15S & blind duplicate MW-51S, MW-22S & blind duplicate MW-88S (CEM sample only)).
"S" series wells are open to perched ground water.
All samples collected from dedicated bladder pumps using low flow/ low volume sampling methods
Monitoring well MW-21S was not sampled due to technical problems with the pump systems.

Table 4-7: Third Quarter 2005 Perched Ground Water Analytical Data Summary

Analyte (units)	RFI Monitoring Well																
	MW-15S	**MW-16S**	**MW-17S**	**MW-18S**	**MW-19S**	**MW-21S**	**MW-22S**	**MW-23S**	**MW-27S**	**MW-28S**	**MW-29S**	**MW-33S**	**MW-34S**	**MW-35S**	**MW-36S**	**MW-37S**	**MW-38S**
Anions (mg/L)																	
Nitrate/nitrite-nitrogen	**0.60**	**730**	**0.67 JH1**	<0.010 JH1	**36 JH1**	**15**	**27**	**360**	**19**	**100**	**2.0**	**2.6**	**2.9**	<0.010	**24**	**710**	**0.073**
Sulfate	**29**	**970**	**29 JH1**	**130 JH1**	**490 JH1**	**530**	**360**	**970**	**120**	**560**	**410**	**990**	**21**	**19**	**1400**	**2400**	**440**
CEMs (µg/L)																	
HMX	<0.26	**31.8**	<0.26	<0.26	<0.26	**9.6**	<0.26	<0.26	**0.68**	**29.1 JH5**	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
RDX	**1.02**	**677**	<0.26	<0.26	**1.42**	**150**	**0.55**	**71.4**	**11.5**	**375 JH5**	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
EGDN	<0.52	<0.52	<0.52	<0.52	**554**	<0.52	**7.5**	<0.52	**322**	<0.52 JH5	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
DEGDN	<0.52	**40.2**	<0.52	<0.52	**8760**	**1.8**	**1.59**	<0.52	**3140**	**3.8 JH5**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
TEGDN	<0.52	**110**	<0.52	<0.52	**1490**	**4.9**	**0.59**	<0.52	**340**	**1.58 JH5**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
NG	<0.52	**167**	<0.52	<0.52	**1.60**	**3.5**	<0.52	<0.52	**4.20**	<0.52 JH5	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
2,4,6-TNT	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26 JH5	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
BTTN	<0.52	**2.22**	<0.52	<0.52	**7.55**	<0.52	<0.52	<0.52	**78.6**	<0.52 JH5	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
2,6-DNT	<0.26	**0.54**	<0.26	<0.26	**0.98**	<0.26	<0.26	<0.26	**0.61**	<0.26 JH5	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
2,4-DNT	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26 JH5	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26	<0.26
TMETN	<0.52	**25.6**	<0.52	<0.52	**134**	**40**	<0.52	<0.52	**513**	**29.6 JH5**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
PETN	<0.52	**17.1**	<0.52	<0.52	<0.52	**2.0**	<0.52	<0.52	<0.52	**13.7 JH5**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52

In those instances where a duplicate sample was analyzed, the average concentration is provided
(MW-15S & blind duplicate MW-51S, MW-16S & blind duplicate MW-61S (CEM sample only)).
"S" series wells are open to perched ground water.
All samples collected from dedicated bladder pumps using low flow/ low volume sampling methods

JH# = Holding time exceeded where the # indicates the number of days past holding time prior to analysis. Potential low bias in reported results.
All nitrate results have a JS132 QA flag. This indicates an elevated matrix spike recovery and a possible high bias in reported detections.

Table 4-8: Fourth Quarter 2005 Perched Ground Water Analytical Data Summary

Analyte (units)	RFI Monitoring Well																
	MW-15S	MW-16S	MW-17S	MW-18S	MW-19S	MW-21S	MW-22S	MW-23S	MW-27S	MW-28S	MW-29S	MW-33S	MW-34S	MW-35S	MW-36S	MW-37S	MW-38S
Anions (mg/L)																	
Nitrate/nitrite-nitrogen	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulfate	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CEMs (µg/L)																	
HMX	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
RDX	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
EGDN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
DEGDN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TEGDN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
NG	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,4,6-TNT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
BTTN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,6-DNT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,4-DNT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TMETN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PETN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

In those instances where a duplicate sample was analyzed, the average concentration is provided

"S" series wells are open to perched ground water.
All samples collected from dedicated bladder pumps using low flow/ low volume sampling methods

NS Not sampled

As illustrated in Figure 4-16, sulfate has been detected in all perched ground water monitoring wells and is a ubiquitous constituent in all wells sampled in the monitoring program. Sulfate in ground water occurs both naturally, resulting from the dissolution of sulfate-bearing minerals in rocks and sediments, and may also be related to the historic use of sulfuric acid during production operations and wastewater management in general. Sulfate is useful monitoring parameter in perched ground water because of its association with historic manufacturing activities in this area. Sulfate concentrations in perched ground water range from <20 mg/L to 2,500 mg/L. Lower sulfate concentrations (<50 mg/L) in perched ground water are detected in MW-15S and MW-17S which are located in recharge areas immediately adjacent to the mountain front. Higher sulfate concentrations (between 400 and 2,300 mg/L) are typically found in wells proximal to historic wastewater conveyance structures (MW-16S, MW-19S, MW-21S, MW-22S, MW-23S, MW-28S, MW-36S, MW-37S and MW-38S). Intermediate sulfate concentrations (between 100 to 200 mg/L) are observed in MW-18S, MW-27S, MW-29S, MW-34S and MW-35S. The sulfate concentration in MW-33S appears to be anomalously high considering its location west of the graben, relatively low concentrations of nitrate-nitrogen and lack of CEMs. A statistically significant downward trend in sulfate concentrations is present at MW-19S; otherwise no statistically significant sulfate concentration trends (upward or downward) are observed in the other monitoring wells open to perched ground water based on the available data.

Since monitoring began in 2000, HMX has been detected at least one time in eight of the fourteen perched ground water monitoring wells. Plots of HMX concentrations over time are presented in Figure 4-17. HMX was only detected in four monitoring wells (MW-16S, MW-21S, MW-27S and MW-28S) during 2005. HMX concentrations in these three wells ranged from approximately <1 to 33 μg/L during 2005. Statistically significant downward trends are observed at MW-16S and MW-28S with no trends observed at MW-21S or MW-27S. The presence and distribution of HMX is consistent with historic manufacturing activities.

During 2005, RDX was detected in eight of the perched ground water monitoring wells. Plots of RDX concentrations over time are presented in Figure 4-18. RDX concentrations in perched ground water ranged from <1 μg/L to 756 μg/L during 2005. The highest concentrations of RDX continue to be found in monitoring wells MW-16S, MW-21S, MW-23S and MW-28S, although based upon 2005 data, RDX concentrations in these four wells are approximately 20% to 50% lower than the highest concentrations detected during the monitoring program. Statistically significant downward trends in RDX concentrations are observed in monitoring wells MW-16S, MW-22S and MW-28S. No trends are present at other wells where RDX has been detected. The presence and distribution of RDX is consistent with historic operations in this area. The lack of RDX, or any other CEMs, in monitoring wells MW-36S, MW-37S and MW-38S is notable considering the concentrations of RDX observed in proximal wells MW-16S, MW-23S and MW-28S.

Since monitoring began in 2000, TNT has been sporadically detected at concentrations of <1 μg/L in only two monitoring wells (MW-27S and MW-28S) over the course of the perched ground water monitoring program. Plots of TNT concentrations over time are presented in Figure 4-19. TNT was not detected in any monitoring well during 2005. TNT was not historically used in this area and the infrequent, low detections and limited distribution of TNT in perched ground water is consistent with this history.

The CEM compound 2,6-DNT has been detected in five of the perched ground water monitoring wells at concentrations of <4 μg/L and was only detected in MW-16S, MW-19S and MW-27S during 2005. Plots of 2,6-DNT concentrations over time are presented in Figure 4-20. There are no statistically significant concentration trends observed in these wells. The five wells where 2,6-DNT has been detected (MW-16S, MW-19S, MW-21S, MW-22S and MW-27S) are all located near the conveyance channel originating from the old nitroglycerin/specialty nitrates building (SWMU 31). A 1957 map of the facility from the nitroglycerin production period indicates the presence of a "DNT Heater House" in this area of the plant.

The CEM compound 2,4-DNT has not been detected in perched ground water.

Nitroglycerin has been detected in six monitoring wells and is consistently detected in four monitoring wells open to perched ground water (MW-16S, MW-19S, MW-21S and MW-27S). During 2005, nitroglycerin was detected only once at a trace concentration in MW-28S and was not detected at all in MW-22S. The highest concentrations (≤245 μg/L during 2005) are found in MW-16S. This represents a nearly 75% reduction in nitroglycerin concentration from a high of >800 mg/L in 2001. Nitroglycerin concentrations in the remaining wells were all <5 μg/L in 2005. Plots of nitroglycerin concentrations over time are presented in Figure 4-21. Statistically significant downward trends are observed in MW-16S, MW-19S, MW-22S and MW-27S. No upward trends are present at any well. These wells are located adjacent to the wastewater conveyance channel originating at the former nitroglycerin nitration building. The presence and distribution of nitroglycerin in perched ground water is consistent with historic activities related to the manufacture of nitroglycerin.

Plots of EGDN, DEGDN, TEGDN, BTTN and TMETN concentrations over time are presented in Figure 4-22 through 4-26, respectively. A precipitous decrease in concentrations observed in MW-16S, MW-19S and MW-22S for several of the specialty nitrate compounds are clearly evident in the concentration plots. No statistically significant increasing trends are observed at any well. Decreasing concentration trends are observed at the following wells for each constituent:

EGDN	MW-16S, MW-19S, MW-22S, MW-27S and MW-28S
DEGDN	MW-16S, MW-21S, MW-22S, MW-27S and MW-28S
TEGDN	MW-16S, MW-21S, MW-22S, MW-27S and MW-28S
BTTN	MW-16S
TMETN	MW-16S, MW-22S and MW-28S

The concentrations of several specialty nitrate compounds at some locations may be attributed to the high solubility of the specialty nitrate compounds relative to other CEMs. Specialty nitrates have not been detected at MW-23S and are found at reduced concentrations at MW-28S, both of which are located north of monitoring wells where higher concentrations are found (MW-19S, MW-21S, MW-22S and MW-27S). The presence and distribution of these specialty nitrate esters is consistent with historic operations in this area.

PETN has been detected in eight perched ground water monitoring wells (MW-15S, MW-16S, MW-18S, MW-19S, MW-21S, MW-22S, MW-27S and MW-28S). Plots of PETN concentrations over time are presented in Figure 4-27. During 2005, PETN was not detected in MW-15S, MW-18S, MW-19S, MW-22S or MW-27S. The highest PETN concentrations are found in MW-16S and ranged from approximately 17 to 22 µg/L during 2005. These PETN concentrations are approximately 80% lower than the highest concentrations detected in MW-16S during 2001. PETN concentrations in the remaining wells were <15 µg/L during 2005. Statistically significant downward trends are observed at MW-16S and MW-28S with no trends at other monitoring wells where PETN has been detected.

Tetranitrocarbazole (TNC) has not been detected in perched ground water during any sampling and was not analyzed for in 2005.

As described previously, three perched ground water monitoring wells (MW-29S, MW-33S and MW-34S) have been constructed on the plateau west of antithetic fault bounding the graben. CEMs have not been detected in these three wells and nitrate-nitrogen concentrations remain low relative to several monitoring wells within the graben. Sulfate concentrations in MW-33S appear to be anomalously high relative to MW-29S and MW-34S. The water level elevation in MW-33S indicates that this well is open to a deeper perched saturated interval than MW-29S, MW-34S and perched ground water wells within the graben. The sum total of these data suggests that a significant perched ground water migration pathway across the antithetic fault is not present.

Monitoring well MW-35S, constructed within and near the northern terminus of the graben, has low nitrate-nitrogen and sulfate concentrations and no CEMs. While a hydraulic connection between perched ground water and the regional aquifer in the area of the Crowd Canyon alluvium is inferred, data from MW-35S suggests that a northerly perched ground water migration pathway within the graben does not represent an ongoing source of solutes to the regional aquifer. However, as established in the CAP and other reports, a northerly perched ground water migration pathway was likely present in the past when hydraulic conditions were affected by wastewater management practices.

Several rounds of water quality data from the three newest perched ground water wells (MW-36S, MW-37S and MW-38S) are available. As shown in Figure 4-14, these wells are located in the general vicinity of the former north impoundment and in close proximity to one another and nearby monitoring wells MW-16S, MW-23S and MW-28S, where higher concentrations of RDX and other CEMs are detected. No CEMs are present in the three new wells, suggesting that CEM distribution is narrowly constrained east to west in this area. This is consistent with historic production operations and linear source areas such as the former wastewater conveyance structure; however, the lack of CEMs is notable considering the concentrations observed in nearby monitoring wells. Similar to what is observed at MW-23S and MW-28S, elevated nitrate-nitrogen is detected in MW-36S and MW-37S and may reflect the proximity of these wells to the former nitric acid ponds. The nitrate-nitrogen concentration in MW-38S is <1 mg/L. Relatively high sulfate concentrations are also present in MW-36S and MW-37S with lower but still elevated levels of sulfate in MW-38S. This is consistent with elevated sulfate levels present in wells proximal to former wastewater management areas.

Fourteen monitoring wells open to perched ground water and five monitoring wells open to the regional aquifer have been constructed within the graben. A comparison of water quality data from perched ground water and regional aquifer wells continues to illustrate a dichotomy in constituent concentrations. Higher concentrations of nitrate-nitrogen, sulfate and various CEMs are observed in perched ground water in the northeast corner of the EBCo site in the vicinity of SWMUs 1 and 30, whereas substantially lower concentrations or non-detections are observed for the regional aquifer wells in the same area. This is particularly notable at the MW-16S/MW-16D well pair where higher concentrations of CEMs were detected at MW-16S and no CEMs were detected in MW-16D. Similarly, only trace concentrations (<1 µg/L) of EGDN have been reported as detected in FW-2 (four detections in 2004 and no detections in 2005) which is located in close proximity to MW-19S and MW-27S where elevated concentrations of CEMs have been identified. Monitoring well MW-28S contains substantially higher concentrations of nitrate-nitrogen, RDX and other CEMs than are found in MW-28D. These data, along with geologic information and observations regarding the lack of continuously saturated conditions in the interval between the base of the perched ground water and the top of the zone of saturation of the regional unconsolidated aquifer, provide evidence that perched ground water is not migrating directly vertically downward to the underlying regional unconsolidated aquifer in vicinity of MW-16D and FW-2. Although low concentrations of CEMs and nitrate-nitrogen have been found at MW-28D, it is unlikely that the source is vertical downward ground water movement because this pathway is unfavorable due to the presence of thick intervening clay units and the lack of continuously saturated conditions. The historic practice of wastewater management in the wastewater dispersion area is a more plausible source for solutes reaching the regional aquifer in the area of MW-28D and other wells open to the regional aquifer in the vicinity. The sum total of available information suggests that during periods of active wastewater management, an interval of perched ground water was present at a depth of approximately 40-feet below ground surface, supported by a locally laterally extensive clay layer. This clay layer dips slightly eastward, towards the mountain as a result of back rotation due to faulting along the Wasatch Fault. Historically, perched ground water likely moved both northward out of the throat of the graben and eastward following the dip of the upper clay surface. Perched ground water flowing north would have entered coarse alluvial deposits associated with Crowd Canyon and then would have been dispersed into the regional aquifer. Perched ground water flowing east toward the mountain would have encountered a thick vertical sequence of relatively coarse alluvial, colluvial and beach deposits. These coarse materials may have provided a vertical perched ground water migration pathway to the regional aquifer where it was likely dispersed to the west and north. This shallow zone of perched ground water is no longer present. The geology and hydrogeology of this area continue to be evaluated.

4.2.2 General Water Chemistry

No additional general water chemistry data were collected from monitoring wells open to perched ground water. A piper diagram containing the latest perched ground water general water chemistry data is presented in the *2004 Ground Water Annual Report* (Charter Oak, 2005) along with a discussion of observations.

4.2.3 Water Level Data

Water levels were measured at a bimonthly frequency from the perched ground water wells. Hydrographs, illustrating water level elevation variations for the perched ground water wells are presented in Figure 4-28. These hydrographs indicate declining or relatively stable level trends at all well locations, although water levels at MW-27S and MW-28S appear to have increased slightly during 2005. Mann-Kendall analysis confirms the existence of declining water level trends in all perched ground water monitoring wells except MW-33S and MW-35S where no trends in water levels are present. No long term increasing water level trends are observed at any of these wells. As presented in the Migration to Regional Aquifer Work Plan (Charter Oak, 2004c) water levels in some perched ground water monitoring wells were observed to vary over a foot in response to changes in barometric pressure and this is the cause of much of the variability in water levels measured at these wells. Water level variations in the perched ground system are substantially less than what is observed in the regional unconsolidated aquifer and no obvious seasonal fluctuations are observed. Water level elevation data used to create these hydrographs are presented in Appendix C.

Water levels in MW-18S are more than thirty-five feet higher than those observed in other monitoring wells open to perched ground water. This may reflect the surface of a laterally continuous perched ground water system. Alternatively, MW-18S may be open to a different (higher) perched zone than the other monitoring wells. Saturated conditions at depths consistent with other perched ground water monitoring wells within the graben were not noted in MW-18D, located approximately 100 feet north of MW-18S.

Water levels in monitoring well MW-33S remain approximately forty to fifty feet lower than water levels measured in monitoring wells located within the graben to the east. The saturated thickness encountered in this area (approximately 2 feet) is also substantially less than observed at locations within the graben. It is our interpretation that MW-33S is open to a different perched zone than the other monitoring wells. Lithologic data from the well logs is supportive of this interpretation.

Figure 4-29 is a map illustrating perched ground-water water table elevations based on water level data collected in September of 2005. The water level at MW-28S appears anomalously high when compared to water levels from nearby wells. The reason for this apparent anomaly is the subject of continuing evaluation. No discernable change in the distribution of perched ground-water water levels was observed during the year.

4.3 2005 Data Report

Nitrate-nitrogen, sulfate and general water quality parameters are analyzed using standard laboratory methods. These analyses were performed by American West Analytical Services (AWAL). Southwest Research Institute (SwRI) provides analytical services for the analysis of CEMs for all ground water samples. SwRI uses a modified version of SW846-8330 to analyze for CEMs. The method has been modified to enable the detection and quantification of several CEMs that are not on the standard SW846-8330 analyte list, including PETN, EGDN, DEGDN, TEGDN, TMETN and BTTN. Both AWAL and SwRI are certified by the Utah Department of Laboratory Services to perform these analyses.

Scanned images of complete laboratory reports for nitrate-nitrogen, sulfate and CEMs collected by Charter Oak during 2005 are provided in electronic format on the CD-ROM attached as Appendix E. These files are in PDF format and can be viewed using an Adobe Acrobat® viewer. The data reports are organized in four categories: 1) GAC Exchange Discharge Sampling; 2) Monthly Extraction Well, GAC Performance and UPDES Sampling; 3) Quarterly Regional Aquifer Sampling; and, 4) Quarterly Perched Ground Water Sampling. Within each category, the analytical reports are grouped by laboratory. Each scanned document has been assigned a filename indicating the month or quarter during which the samples were collected and a laboratory sample designation group number.

With the exception of the following deviations, there are no data gaps with respect to water quality data:

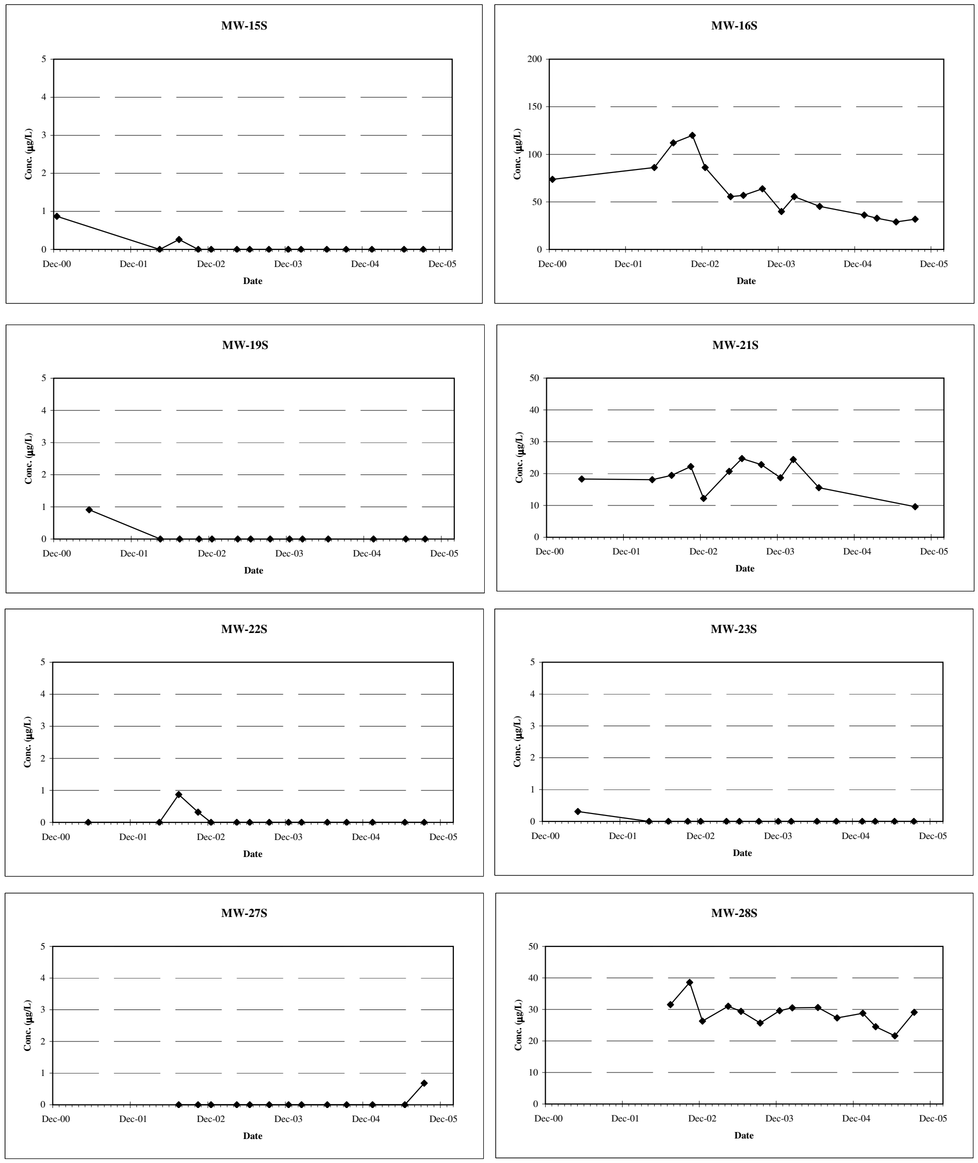
- The Baum well was not sampled during 2005. Per the 2004 Annual Report and CAP Addendum, the Baum well was supposed to be sampled one time for nitrate-nitrogen during 2005. This omission does not adversely affect the ground water monitoring program.
- Due to Spanish Fork City operations, the Olsen well was sampled a single time. Per the 2004 Annual Report and CAP Addendum, the Olsen well was supposed to be sampled three times for nitrate-nitrogen and CEMs during 2005. Sampling of MW-32D and the New Haven well provides adequate coverage in this area.
- Due to access coordination limitations, the Frischknecht, Young and Bluth wells were sampled a single time. Per the 2004 Annual Report and CAP Addendum, the Frischknecht, Young and Bluth wells were supposed to be sampled three times for nitrate-nitrogen and CEMs during 2005. Adequate coverage in this area is provided by the sampling of MW-3D, MW-10D and Orton-23.

- Due to access limitations imposed by the landowner, the Booth well was sampled a single time. Per the 2004 Annual Report and CAP Addendum, the Booth well was supposed to be sampled three times for nitrate-nitrogen and CEMs during 2005. These access limitations also precluded the collection of water level data after August 2005. The omission of the Booth well does not adversely affect the monitoring program due to the sampling of surrounding wells.
- Due to pump malfunction, MW-30D was not sampled during the fourth quarter sampling event. Per the 2004 Annual Report and CAP Addendum, MW-30D was supposed to be sampled quarterly for nitrate-nitrogen and CEMs during 2005. Only low levels of nitrate-nitrogen and no CEMs have been detected in this well. Omission of a single sampling event does not adversely affect the ground water monitoring program.
- Due to ongoing interim measures soil remediation activities on the EBCo site, fourth quarter perched ground water sampling for monitoring wells MW-16S, MW-23S, MW-28S, MW-36S, MW-37S and MW-38S was not performed. In addition, problems with the pump system for MW-21S precluded the collection of one round of samples from this well. Water quality conditions in the perched ground water system do not change rapidly. Temporary suspension of data collection from these wells is not detrimental to the perched ground water monitoring program. Sampling of these wells will continue once interim measures activities are completed.

Figure 4-15: Northeast Area Perched Ground Water Nitrate-Nitrogen Concentrations

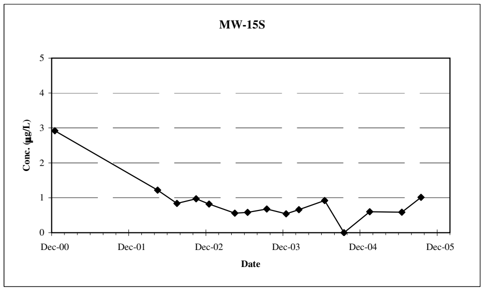
Figure 4-16: Northeast Area Perched Ground Water Sulfate Concentrations

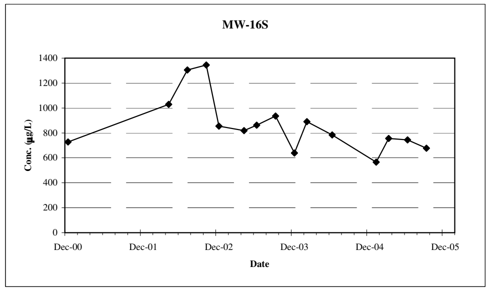
Figure 4-17: Northeast Area Perched Ground Water HMX Concentrations

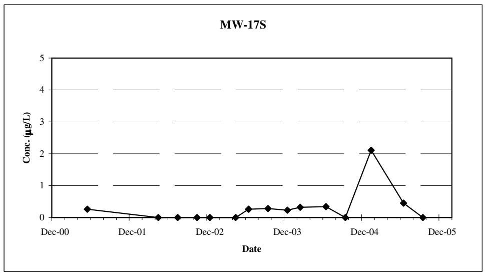


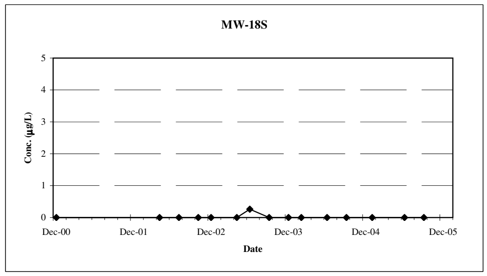
HMX has not been detected in MW-17S, MW-18S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

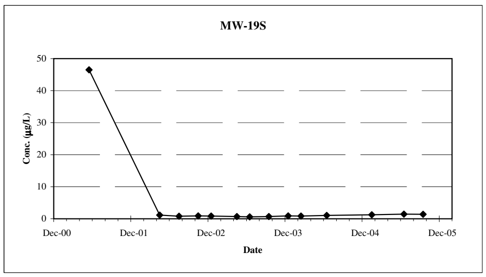
Figure 4-18: Northeast Area Perched Ground Water RDX Concentrations

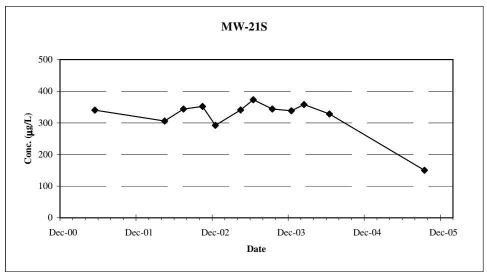


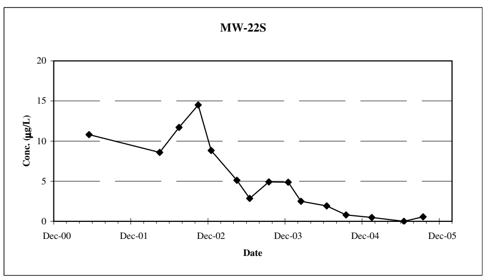


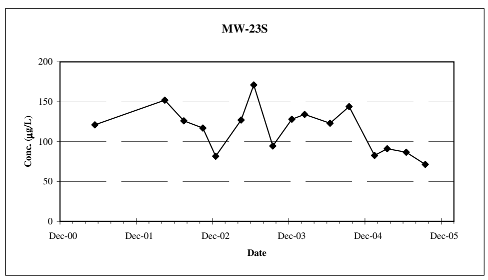


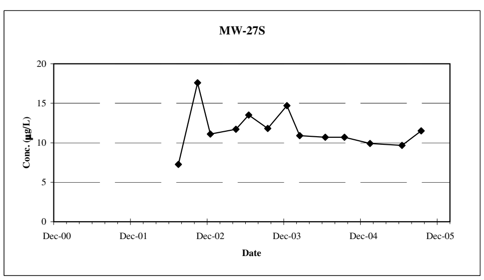


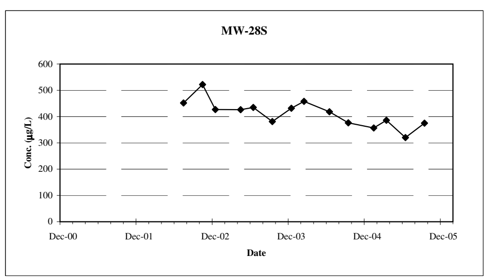






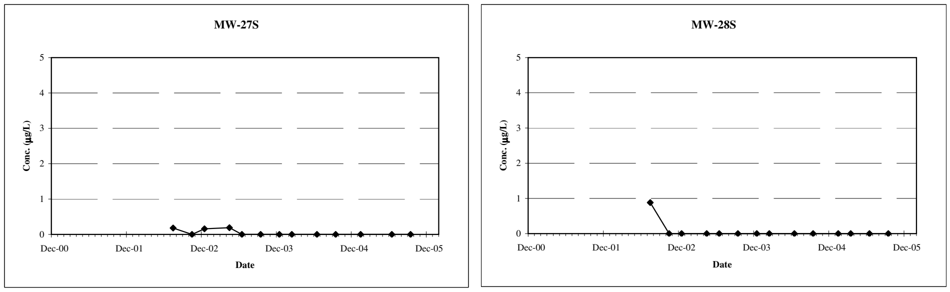






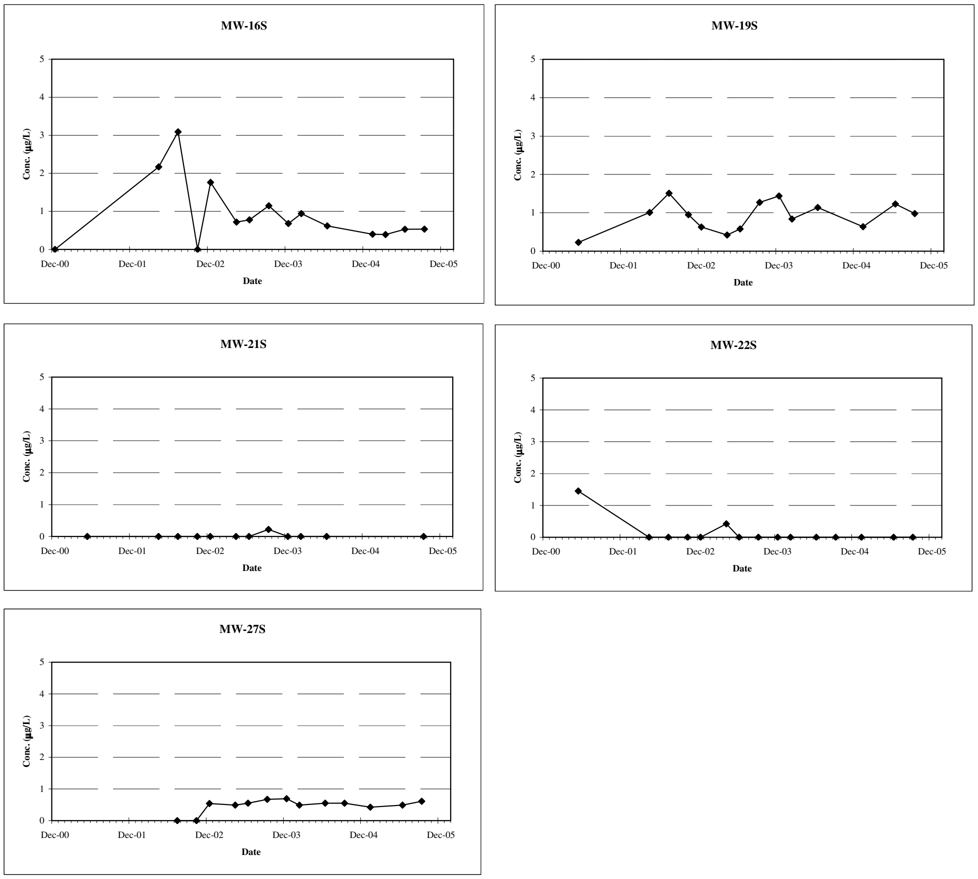
RDX has not been detected in MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

Figure 4-19: Northeast Area Perched Ground Water 2,4,6-TNT Concentrations



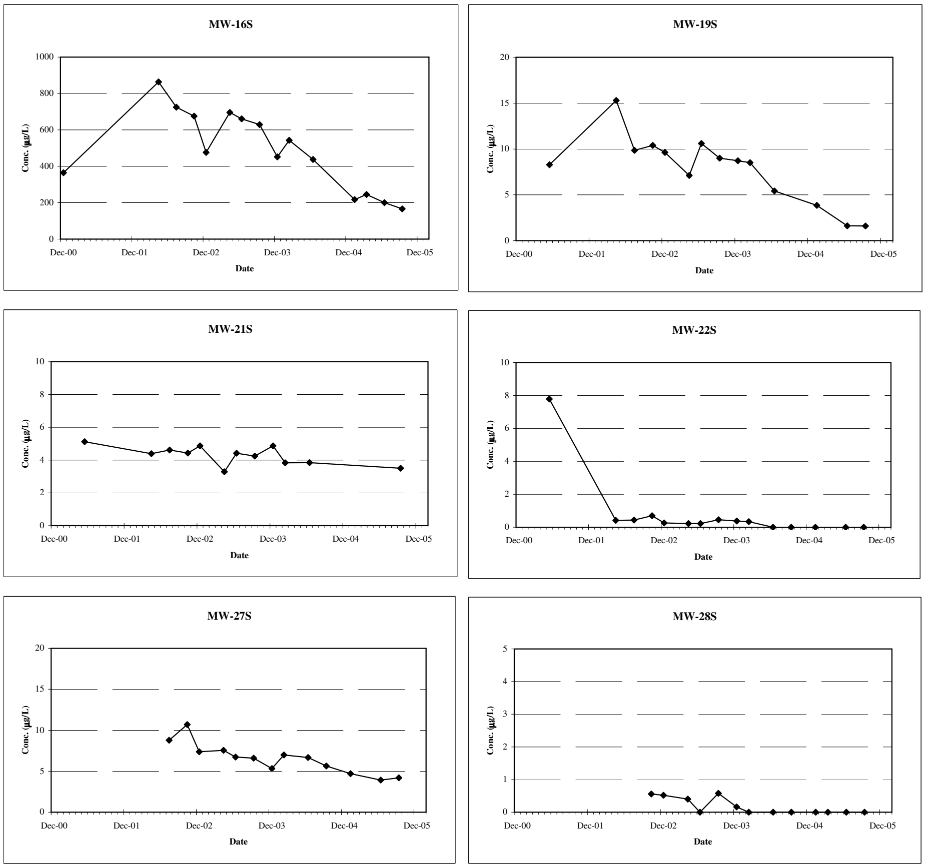
2,4,6-TNT has not been detected in MW-15S, MW-16S, MW-17S, MW-18S, MW-19S, MW-21S, MW-23S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

Figure 4-20: Northeast Area Perched Ground Water 2,6-DNT Concentrations



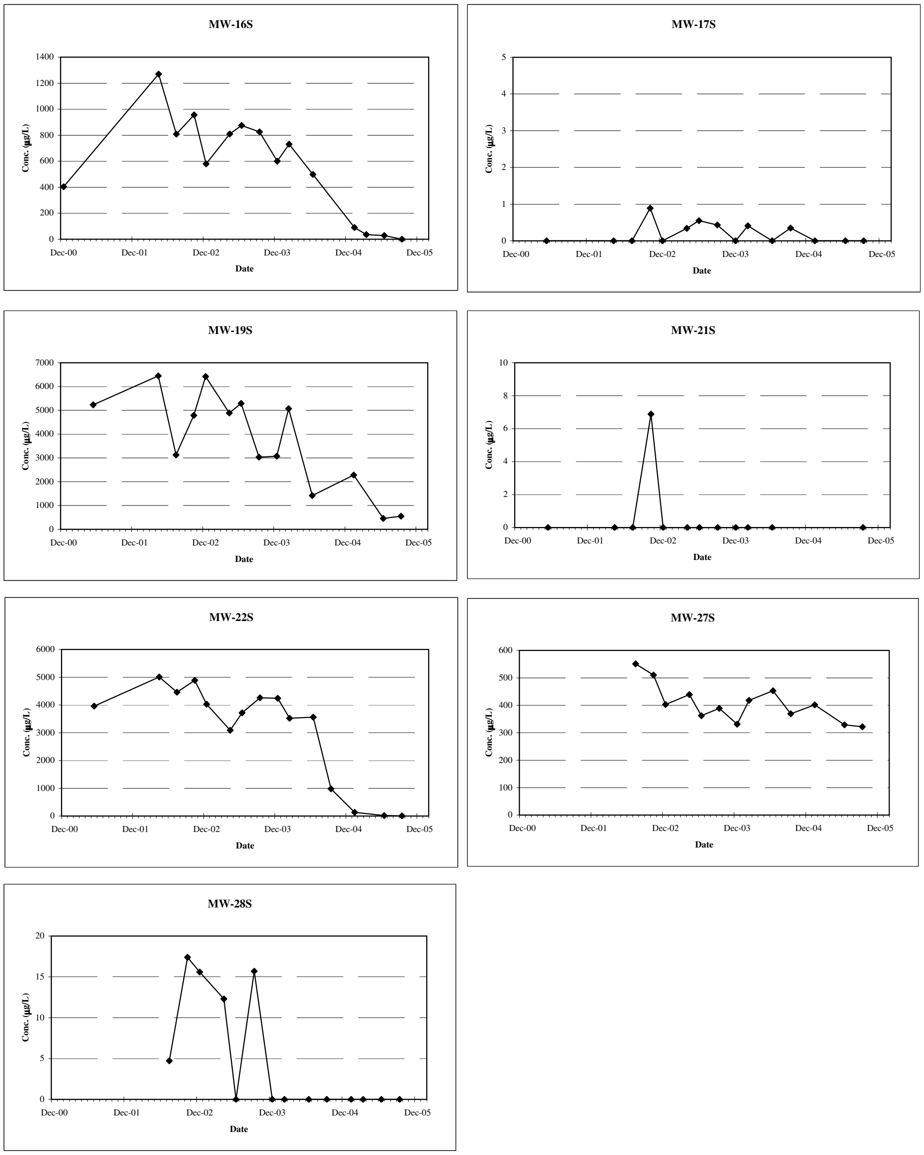
2.6-DNT has not been detected in MW-15S, MW-17S, MW-18S, MW-23S, MW-28S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

Figure 4-21: Northeast Area Perched Ground Water Nitroglycerin Concentrations



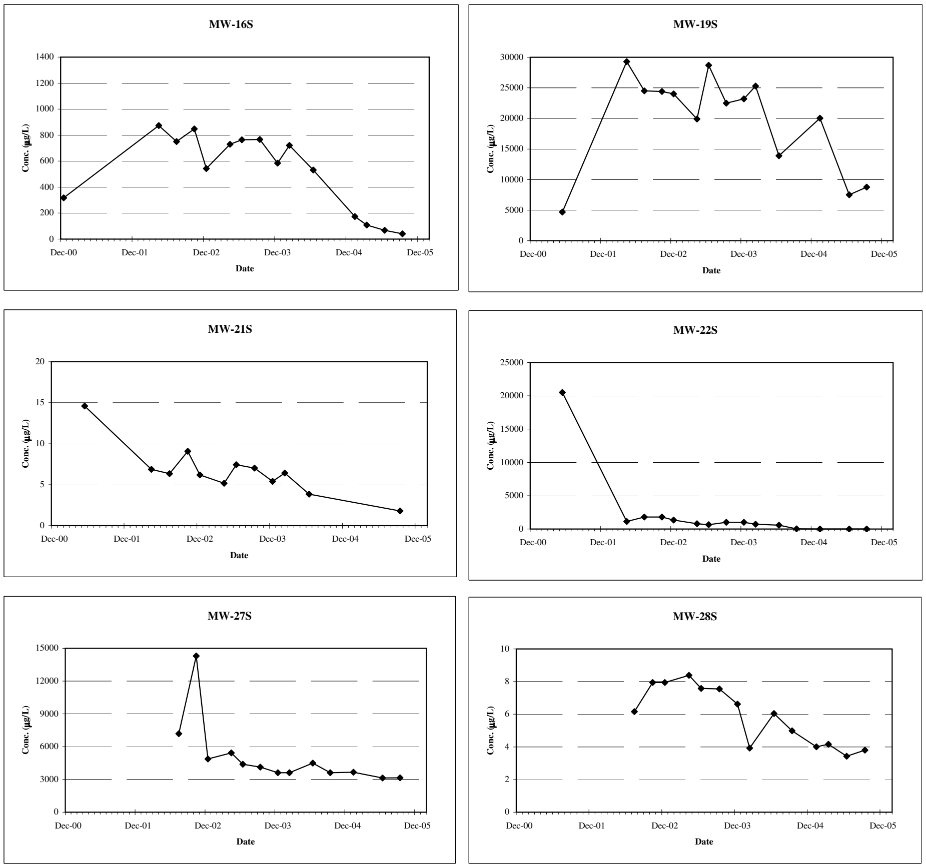
NG has not been detected in MW-15S, MW-17S, MW-18S, MW-23S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

Figure 4-22: Northeast Area Perched Ground Water EGDN Concentrations



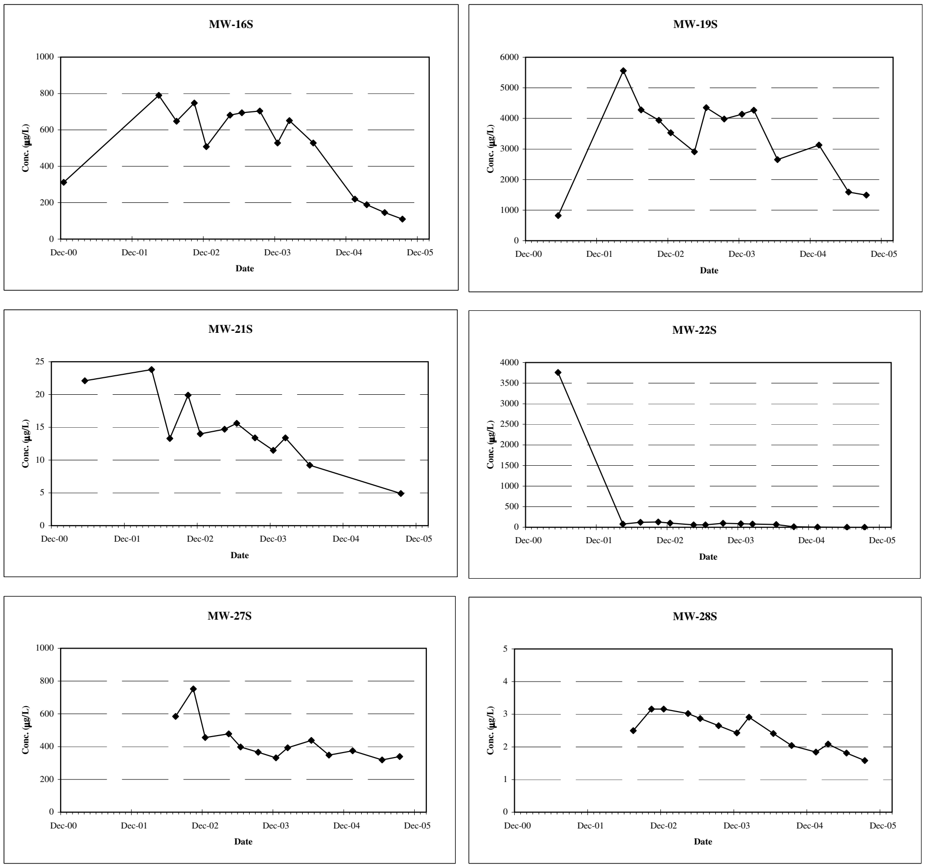
EGDN has not been detected in MW-15S, MW-18S, MW-23S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

Figure 4-23: Northeast Area Perched Ground Water DEGDN Concentrations



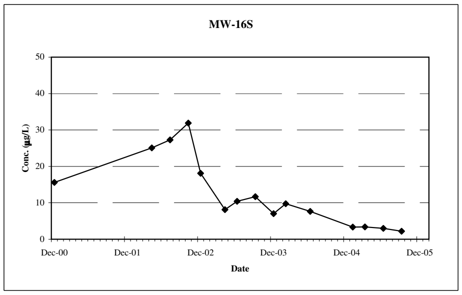
DEGDN has not been detected in MW-15S, MW-17S, MW-18S, MW-23S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

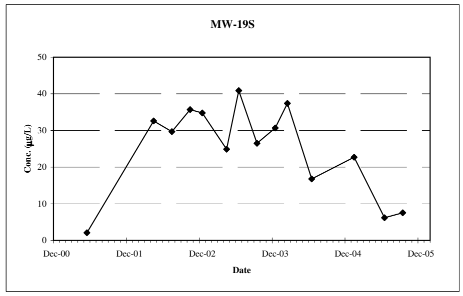
Figure4-24: Northeast Area Perched Ground Water TEGDN Concentrations

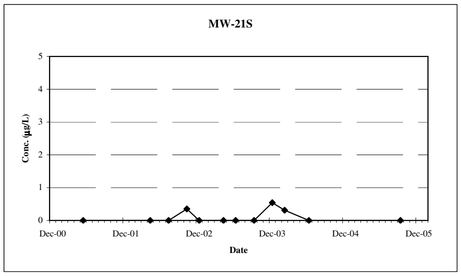


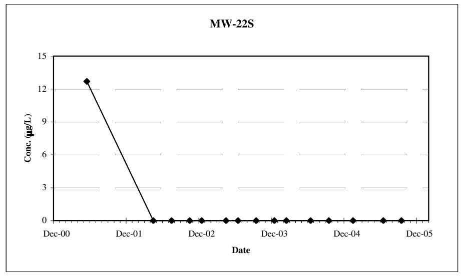
TEGDN has not been detected in MW-15S, MW-17S, MW-18S, MW-23S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

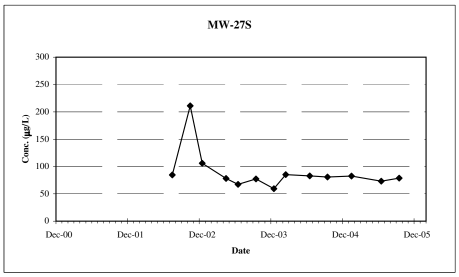
Figure 4-25: Northeast Area Perched Ground Water BTTN Concentrations





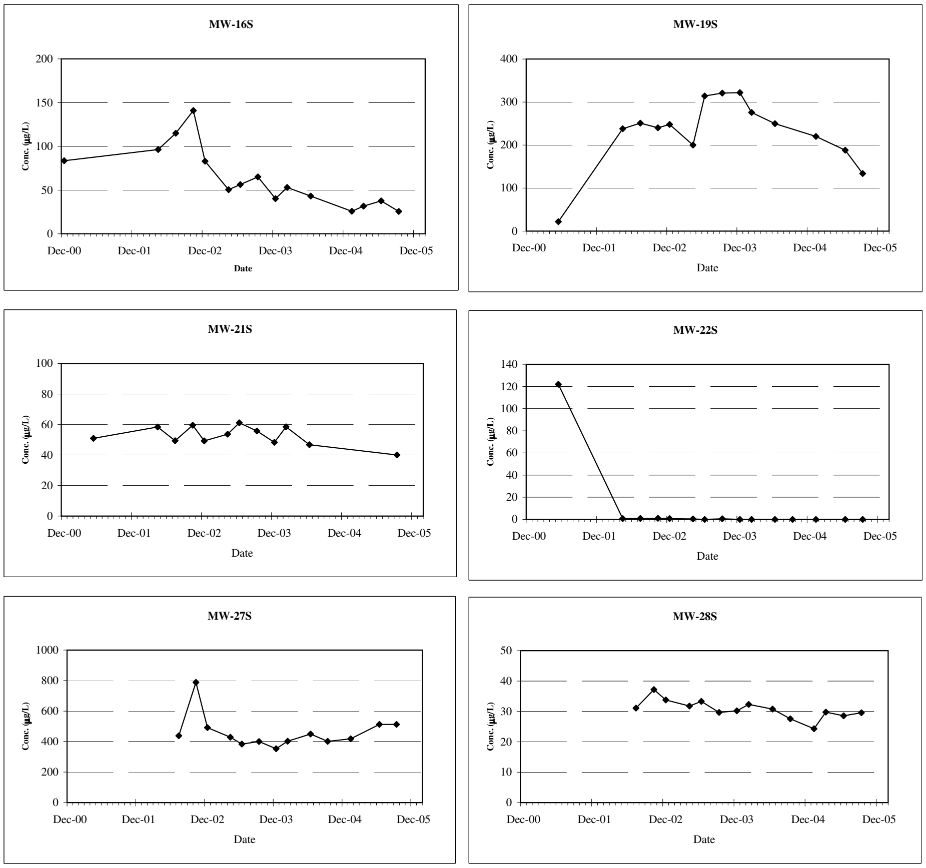






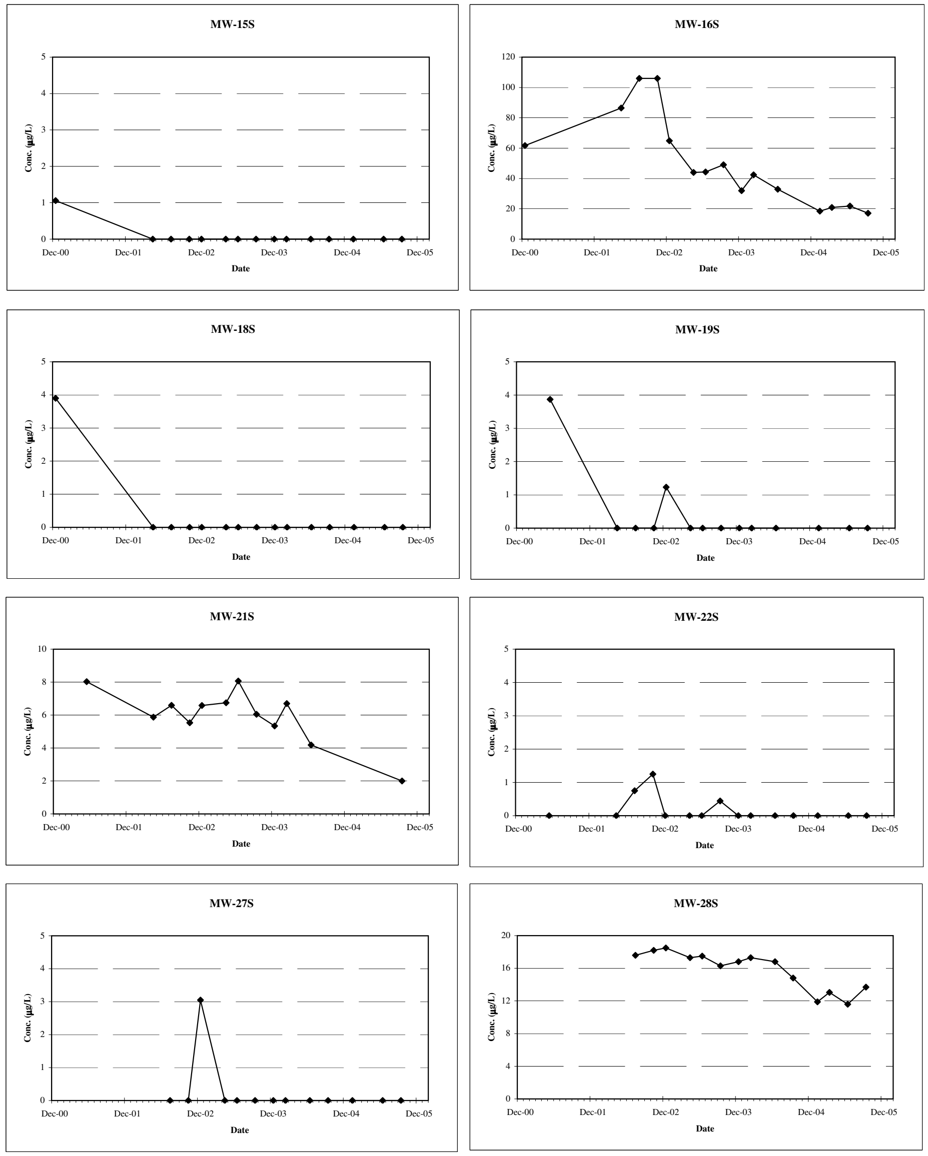
BTTN has not been detected in MW-15S, MW-17S, MW-18S, MW-23S, MW-28S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

Figure 4-26: Northeast Area Perched Ground Water TMETN Concentrations



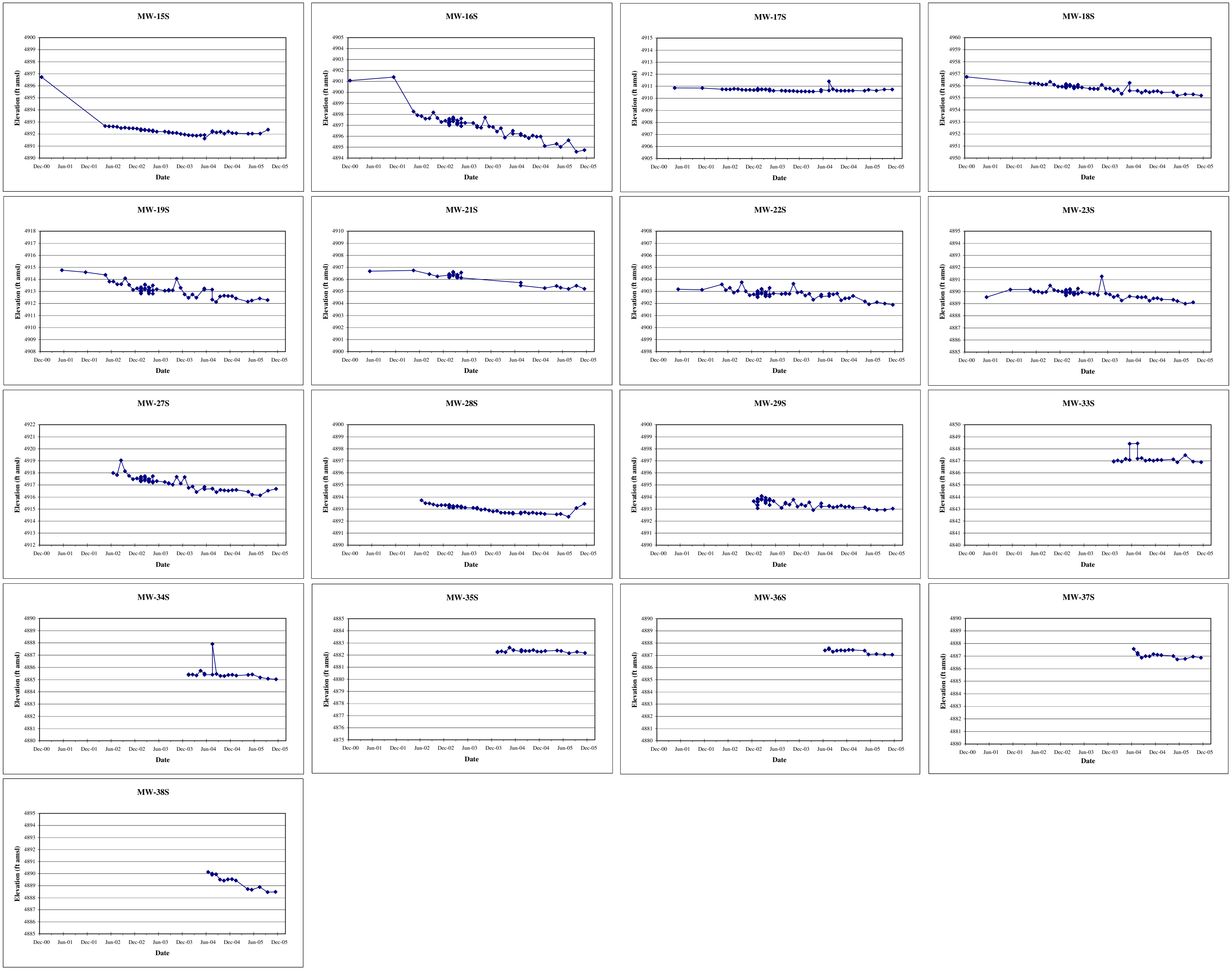
TMETN has not been detected in MW-15S, MW-17S, MW-18S, MW-23S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

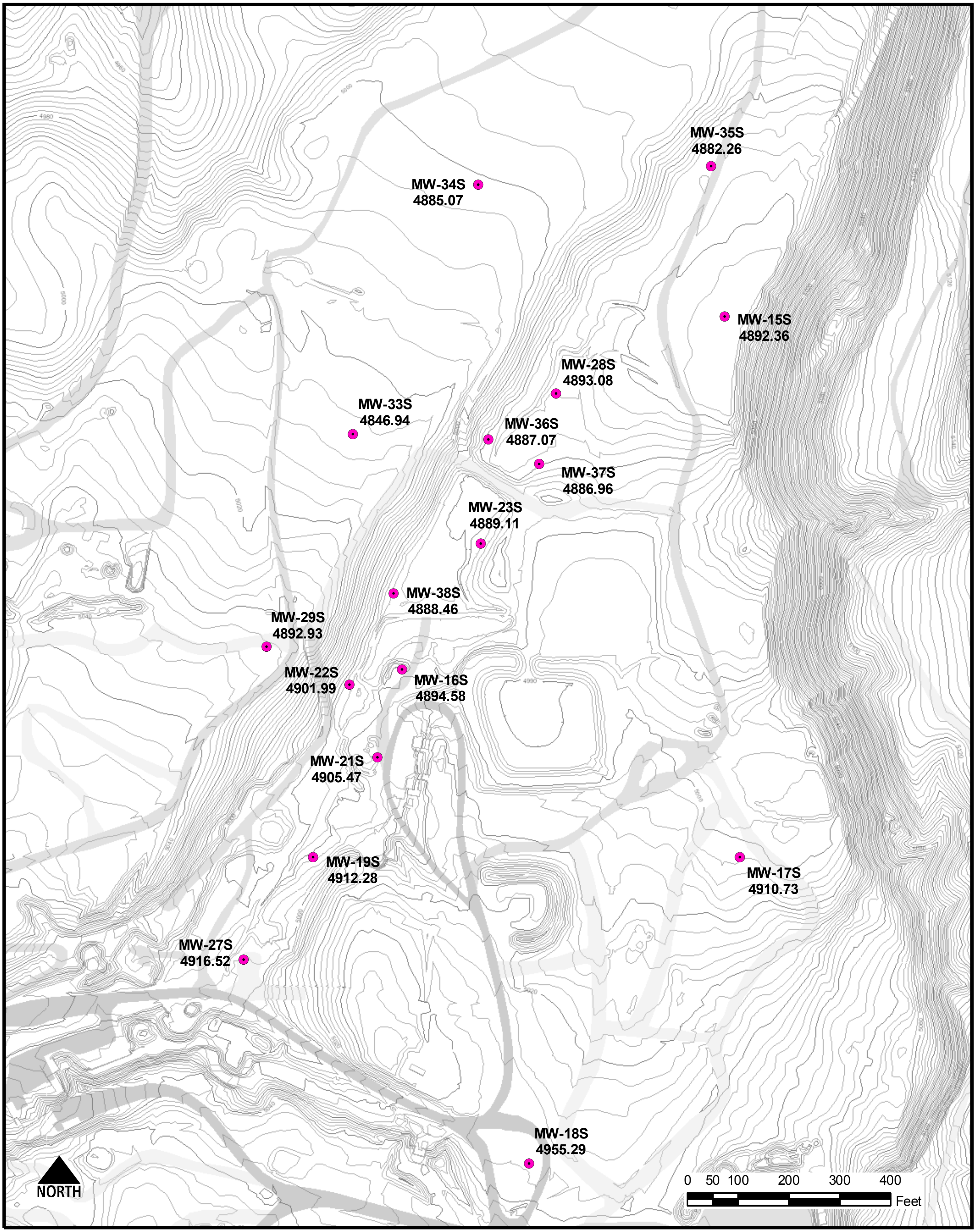
Figure 4-27: Northeast Area Perched Ground Water PETN Concentrations



PETN has not been detected in MW-17S, MW-23S, MW-29S, MW-33S, MW-34S, MW-35S, MW-36S, MW-37S or MW-38S.

Figure 4-28: Perched Ground Water Hydrographs





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**PERCHED GROUND WATER
WATER LEVEL ELEVATIONS
SEPTEMBER 2005**

FIGURE 4-29

5.0 EXTRACTION WELL OPERATIONS AND MONITORING

5.1 Ground Water Extraction Facilities

The ground water extraction system consists of five ground water extraction wells operating in the Spanish Fork Study area. Two wells (Mapleton No. 1 and Orton-23) are high volume municipal/irrigation wells adapted for corrective action purposes and three recovery wells were installed specifically for the ground water remediation project. Extraction well locations are presented in Figure 5-1. Details regarding these extraction wells are presented in the CAP and are not reproduced in this Annual Report. Each of these wells essentially operates continuously except for maintenance or data collection considerations.

5.2 Ground Water Extraction

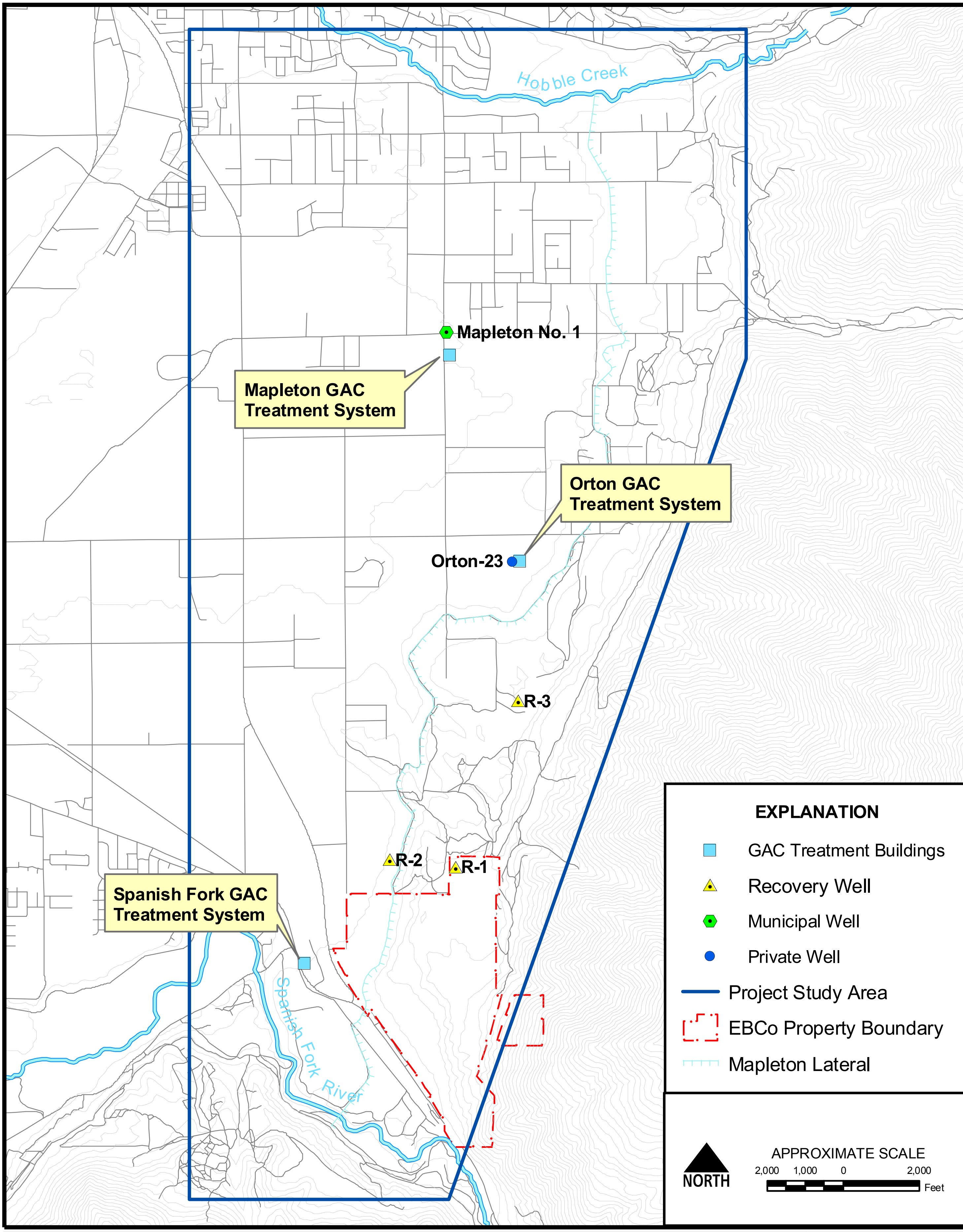
A review of recovery system performance data collected since the start of ground water extraction and treatment operations through the end of calendar year 2005 is presented in this section.

5.2.1 Volumes Extracted

Table 5-1 provides a summary of the volume of water extracted from each recovery well through the end of calendar year 2005. Approximately 5.9 billion gallons of water have been extracted and treated since the beginning of recovery system operations in August 1998. Of this total approximately 1.2 billion gallons (20%) has been beneficially used in the Mapleton and Spanish Fork pressurized irrigation systems.

Table 5-1: Total Volume of Ground Water Extracted and Treated

Extraction Well	Approximate Volume Extracted (million gallons)
R-1	936
R-2	57
R-3	142
Orton-23	1,342
Mapleton No. 1	3,445
Total	**5,922**



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EXTRACTION WELL AND
GAC TREATMENT SYSTEM LOCATION MAP

FIGURE 5-1

5.2.2 Extraction Well Operations and Discharge Rates

Figures 5-2 through 5-6 present average daily discharge rates for each extraction well. These charts are useful for evaluating changes in discharge rates over time. Changes in discharge rates may be caused by either increasing pumping heads (due to water level declines) and/or by the manual or automated lowering of discharge rates to maintain appropriate pumping water levels. These charts also show the pumping history of the recovery wells for comparison with the water level changes observed in the hydrographs presented in the following section.

5.2.2.1 Mapleton No. 1

Figure 5-2 presents the discharge history for the Mapleton No. 1 well. The Mapleton No. 1 discharge remained relatively constant at a rate of between approximately 1,000 and 1,100 gpm until August 2001. Since August 2001 the average discharge rate has been between approximately 880 and 1,000 gpm. During 2005, the average daily discharge rate was approximately 900 gpm. A slow reduction in flow rate over time is evident in this graph. The higher flow rates from August to mid-September 1998 reflect the use of the original pump and motor system, which had a higher discharge rate than anticipated. A smaller pump and motor system was installed in September 1998 and has been in use since that time.

5.2.2.2 Orton-23

Figure 5-3 presents the discharge history for Orton-23. The average daily discharge rate in this well has declined from a high of approximately 1,200 gpm in 1999 to approximately 300 gpm during 2005. The decrease in discharge rate reflects manual and automated flow controls to maintain a suitable pumping water level above the uppermost perforated interval in this well. The Orton well pump has been equipped with a variable frequency drive and automatic level control to avoid drawdown below the upper perforated interval. Beginning in 2002, the flow log illustrates the operation of the variable frequency drive in conjunction with the automatic level control. The flow rate in the well varies to maintain an established pumping water level. The broad sinusoidal pattern in flow rate corresponds to seasonal variations in regional water levels (high in the winter and spring, low in the summer and rising in the autumn). The pattern of sharp spikes observed from 2002 through 2005 reflects the rebound in water levels in response to temporary shutdowns of the well. The pump operates at a higher flow rate until water level conditions stabilize. The long-term sustainable flow rate for this well will vary seasonally and may increase or decrease in response to changing water level conditions.

5.2.2.3 R-1

Figure 5-4 presents the discharge history for R-1. The average daily discharge rate in this well has declined steadily from a high of approximately 450 gpm in 1999 to a low of approximately 180 gpm during 2005. During 2005, the average daily discharge rate was approximately 180 gpm. The decrease in discharge rate reflects manual flow controls to maintain a suitable pumping water level, as water levels have declined in the regional aquifer. The R-1 well was shut down for a period of about one month during February and March of 2003 to facilitate hydrogeologic assessment in the northeast area of the EBCo site.

5.2.2.4 R-2

Figure 5-5 presents the discharge history for R-2. The R-2 well operated on a very limited basis from February 2002 until February 2003 because the overhead telephone lines necessary to safely operate and control the well were damaged by high and sustained winds. Again the R-2 well was operated on a very limited basis between April 2004 and November 2004, and between January 2005 and August 2005 because the underground telephone lines were damaged by excavation equipment. The R-2 well was operated from August 2005 through December of 2005. The average daily discharge rate in this well has declined from approximately 50 gpm in 1999 to approximately 28 gpm in 2005. The decrease in discharge rate reflects manual flow controls to maintain a suitable pumping water level, as water levels have declined in the regional aquifer.

5.2.2.5 R-3

Figure 5-6 presents the discharge history for R-3. The average discharge rate in this well has declined from approximately 110 gpm in 1999 to approximately 36 gpm during 2005. The decrease in discharge rate reflects manual flow controls to maintain a suitable pumping water level as water levels have declined in the regional aquifer. Starting in 2003, the actual average daily discharge rate of the R-3 well is approximately 8 to 10 gpm higher than shown in Figure 4-6. This is because some water from the R-3 well is diverted for private use by the Joyner's prior to being recorded by the sensaphone equipment at the Orton GAC treatment building. R-3 was shut down for approximately 10 months between November 2000 and September 2001 to assess the effect that pumping of the Orton-23 well has on water level trends in this area. The R-3 well was not operated from August 2004 to November 2004 due to mechanical problems with the pump.

5.2.3 Water Level Response

Hydrographs for the extraction wells and selected observation wells help illustrate the influence that the recovery wells have on water levels within the regional aquifer. These

Figure 5-2: Mapleton No. 1 Daily Average Flow Log

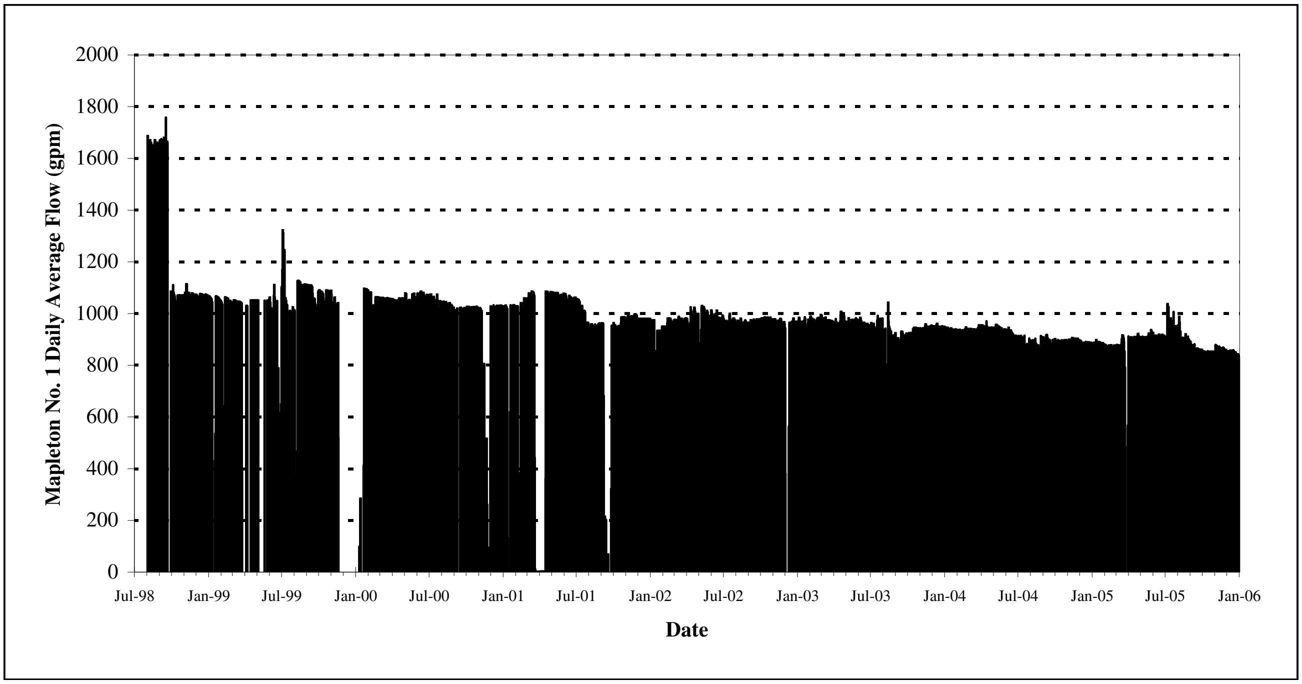


Figure 5-3: Orton-23 Daily Average Flow Log

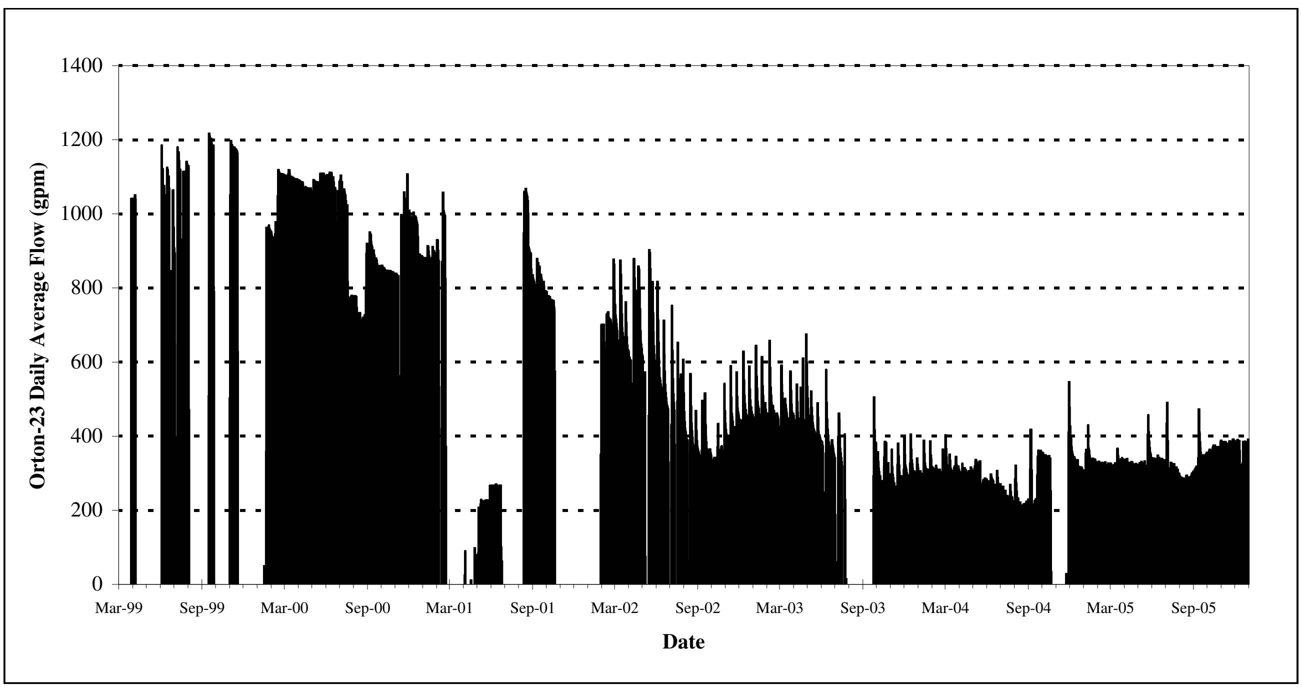


Figure 5-4: R-1 Daily Average Flow Log

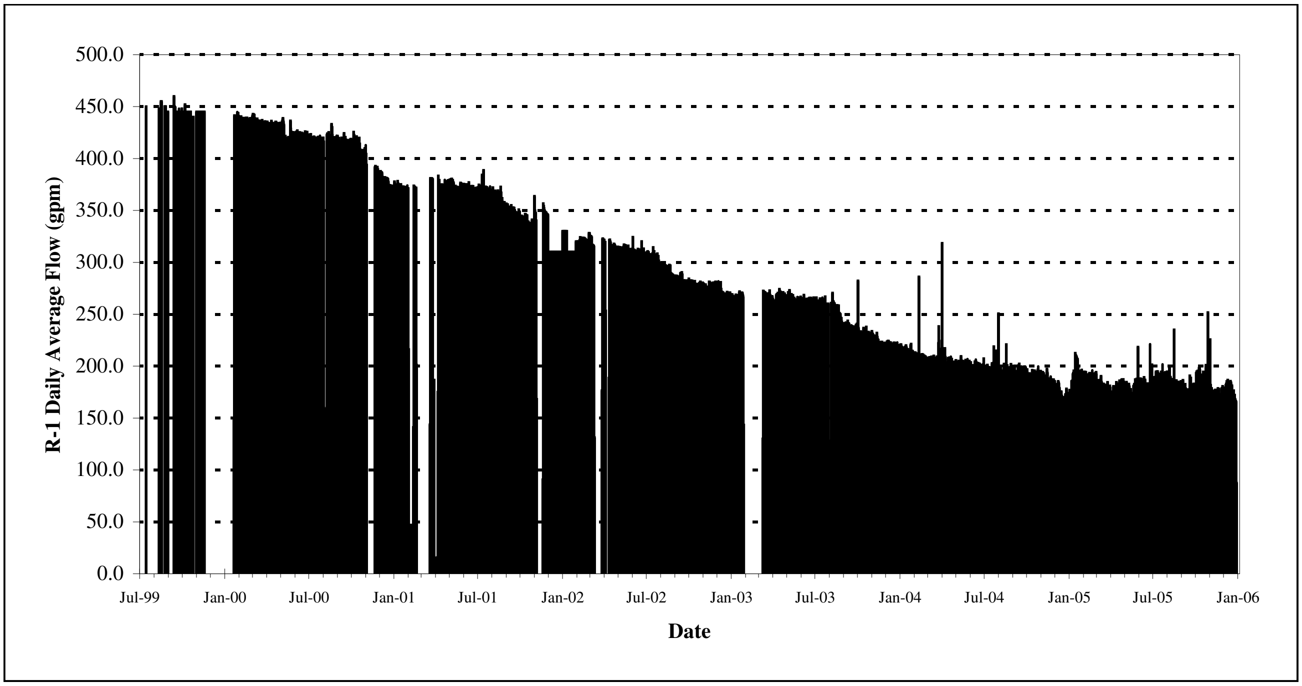


Figure 5-5: R-2 Daily Average Flow Log

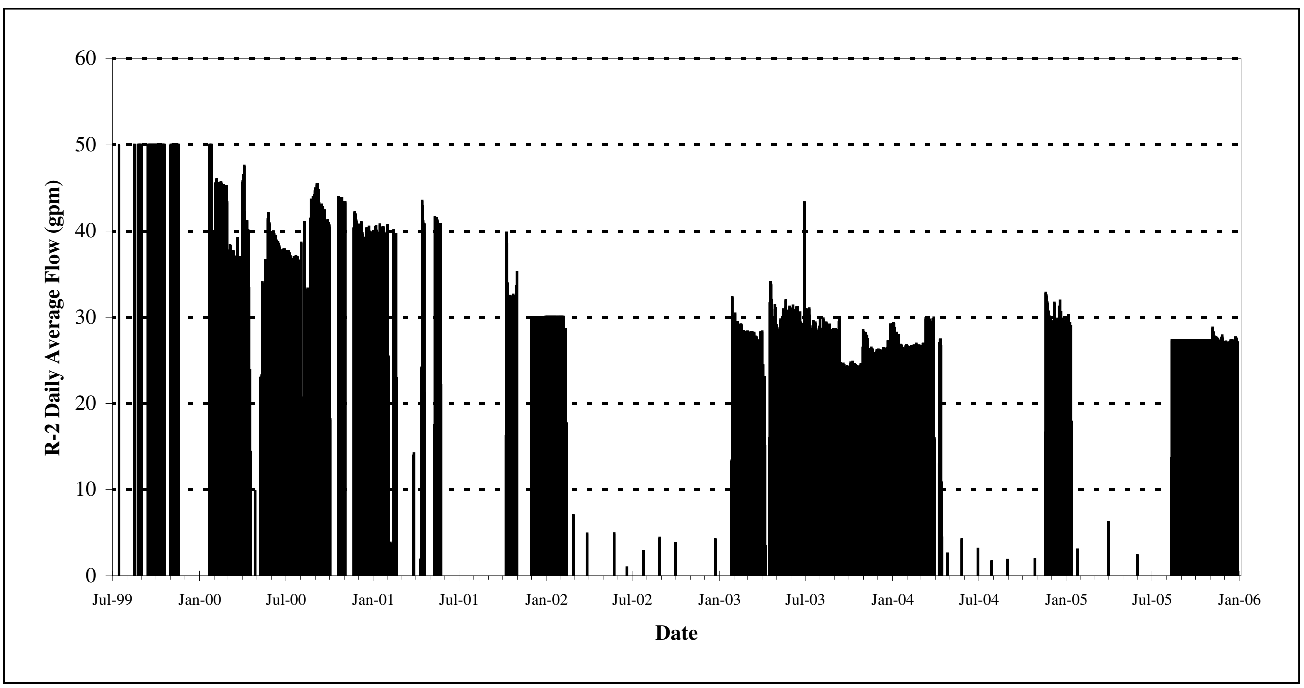
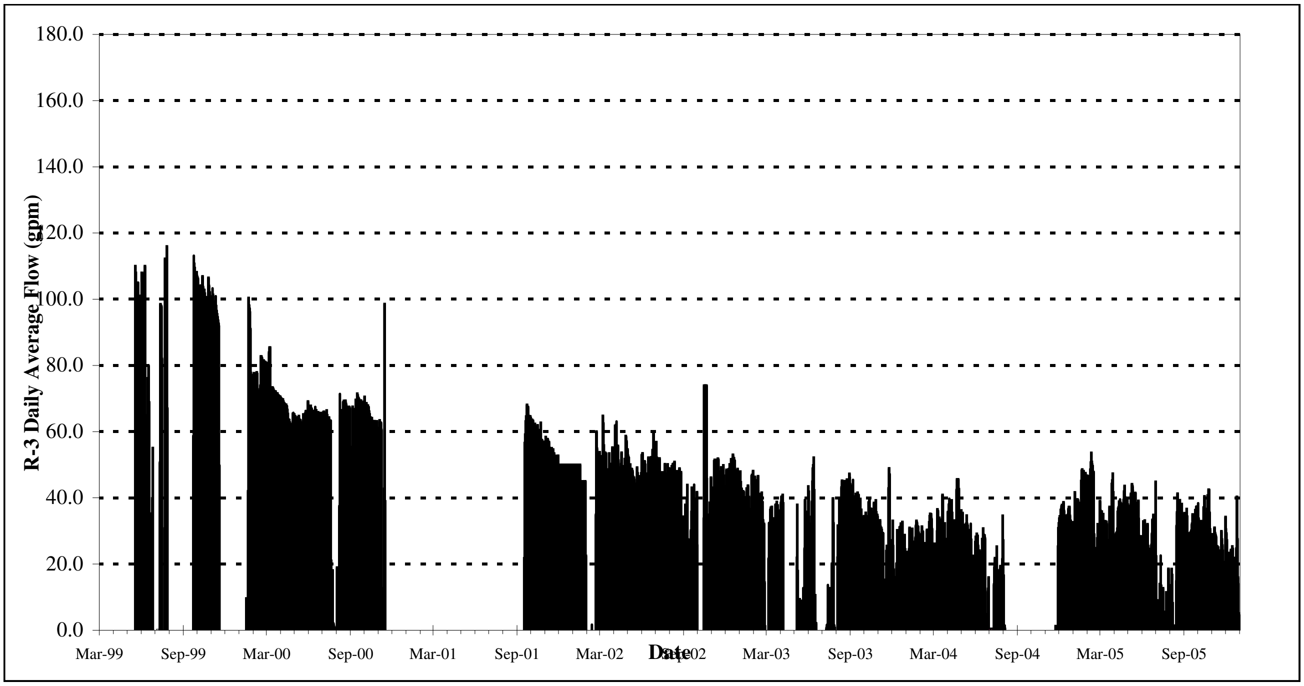


Figure 5-6: R-3 Daily Average Flow Log



hydrographs present data from the approximate start of extraction well operations through the end of calendar year 2005. In the future, water levels will rise and fall in response to changing pumping conditions in the regional aquifer and varying amounts of ground water recharge due to both seasonal and long-term changes in the amount of precipitation.

5.2.3.1 Mapleton No. 1

Figure 5-7 presents hydrographs for the Mapleton No. 1 well and observation wells MW-3D, MW-13D, MW-14D and MW-30D. Aside from periodic shutdowns usually of no more than a few weeks in duration, the Mapleton No. 1 well has been operated consistently from August 1998 through December 2005 at a flow rate of between approximately 900 and 1050 gpm. A cyclical pattern is clearly evident in these hydrographs. The cyclical pattern illustrates seasonal variations in water levels with the highest water level conditions observed during the winter and spring and lowest water level conditions observed during late summer. This pattern results from both seasonal variations in ground water recharge and changing pumping conditions in the regional unconsolidated aquifer in response to increased irrigation needs during the summer months. An overall maximum regional water level decline of approximately 40 to 50 feet is apparent in all of the wells reflecting the drop in water levels due to below average precipitation recharge.

5.2.3.2 Orton-23

Figure 5-8 presents hydrographs for Orton-23 and observation wells MW-10D, MW-31D, Bluth and Young. Operation of the Orton-23 well has varied over time due to equipment problems and planned shutdowns to allow for packer testing and well improvements. Over the past four years, the average flow rate in the Orton-23 well has been lowered from a high of greater than 1,000 gpm to approximately 300 gpm in response to the overall decline in regional water levels. The relatively constant water level observed in Orton-23 starting in 2002 and continuing through 2005 results from the use of an automatic level control which maintains a constant pumping level through the use of a variable speed drive to control flow rate. An overall regional water level decline of between thirty and forty feet is observed in these hydrographs. The seasonal pattern observed at Mapleton No. 1 and adjacent observation wells is less evident at Orton-23, although a seasonal pattern is clearly observed at MW-31D.

5.2.3.3 R-1

Figure 5-9 presents hydrographs for R-1 and observation wells MW-6D, MW-7D, MW-11D, B-9 and FW-2. An overall regional water level decline of between thirty and forty feet is apparent in all of the wells reflecting the drop in water levels due to below average recharge. In contrast to Mapleton No. 1 and Orton-23, no obvious seasonal variations are observed in these hydrographs. This may reflect the proximity to bedrock recharge in this area and distance from other high volume pumping wells in the study area. The hydrograph for the R-1 well demonstrates that the pumping water level in this well is approximately 40 to 50 fifty feet lower than the static, non-pumping conditions. These hydrographs also illustrate that water levels in monitoring wells MW-6D, MW-7D, MW-11D and B-9 respond rapidly to pumping of the R-1 well.

5.2.3.4 R-2

Figure 5-10 presents hydrographs for R-2 and observation wells MW-1S and MW-1D. The R-2 well was shutdown for a period of approximately one year from February 2002 until February 2003 due to damage to the overhead telephone lines used to service the well control equipment. The R-2 well was again shut down from April 2004 through November 2004 and January 2005 through August 2005 due to damage to underground telephone lines. Given the low transmissivity of the materials in which R-2 is set and the low pumping rate of about 30 gpm, the area of measurable influence of this well is limited. A thirty-five to forty foot decline in water levels is observed in these hydrographs over the period of record. No obvious seasonal trends are observed. During 2005, the pumping water level in R-2 was approximately fifty feet lower than static, non-pumping conditions.

5.2.3.5 R-3

Figure 5-11 presents hydrographs for R-3 and observation wells Whiting and Booth. The noise in the R-3 hydrograph from February to November 2000 reflects both variations in pumping rates necessary to maintain pumping water levels above the well intake and numerous starts and stops that are related to power outages, often times triggered by lightning strikes. The R-3 well was shutdown between November 2000 and September 2001 in order to assess the pumping influence of the Orton-23 well. The R-3 well was also shutdown between August 2004 and November 2004 due to mechanical problems with the pump. Water levels in these three wells have declined approximately forty to fifty feet between 1999 and 2005. No obvious seasonal trends are observed. During 2005, the pumping water level in R-3 was approximately forty feet lower than static, non-pumping conditions.

5.2.4 Constituent Concentration Trends

Water quality data are collected from extraction wells on a monthly frequency through 2004 and bi-monthly frequency in 2005. The available data record is insufficient to make any determinations or predictions about future solute behavior and recovery system performance, at this time. This is especially true in the complex hydrogeologic setting of the study area. Additional data collection is required before the ground water solute concentration trends will provide meaningful insight into future solute behavior under the effects of pumping.

Figure 5-7: Mapleton No. 1 Hydrographs

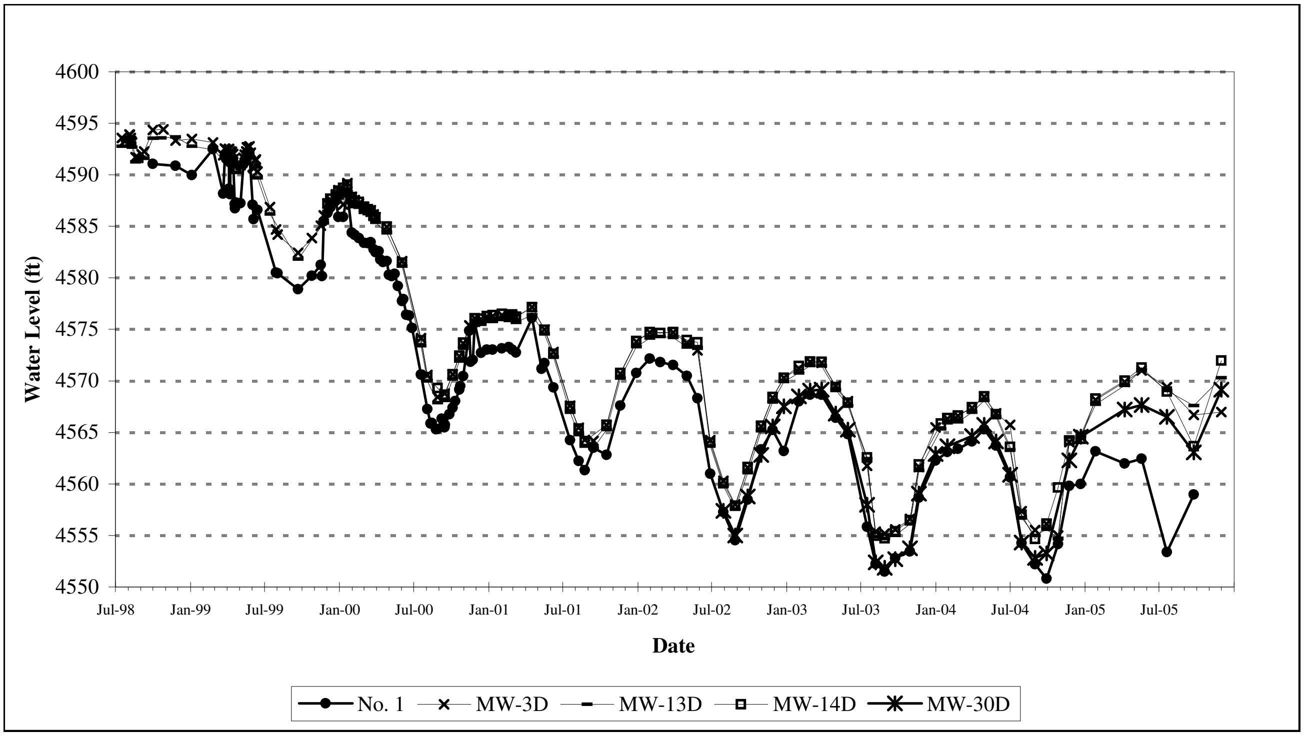


Figure 5-8: Orton-23 Hydrographs

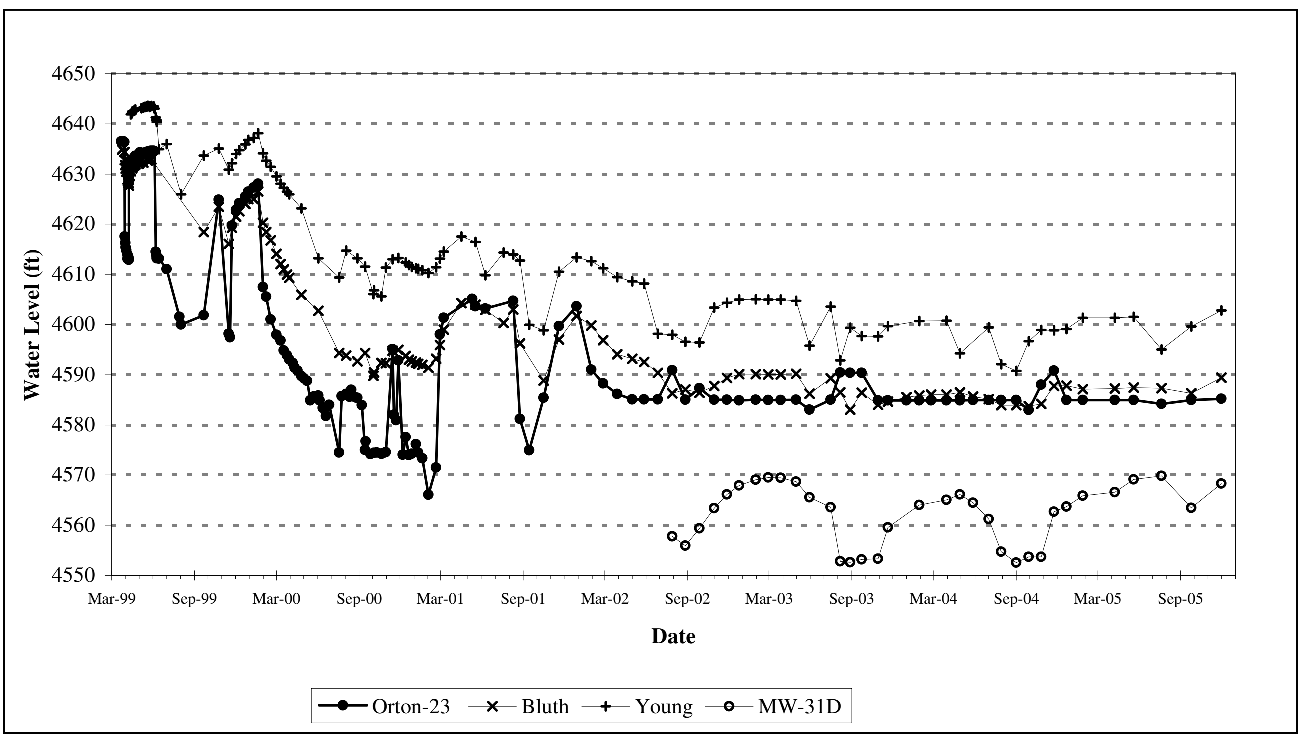


Figure 5-9: R-1 Hydrographs

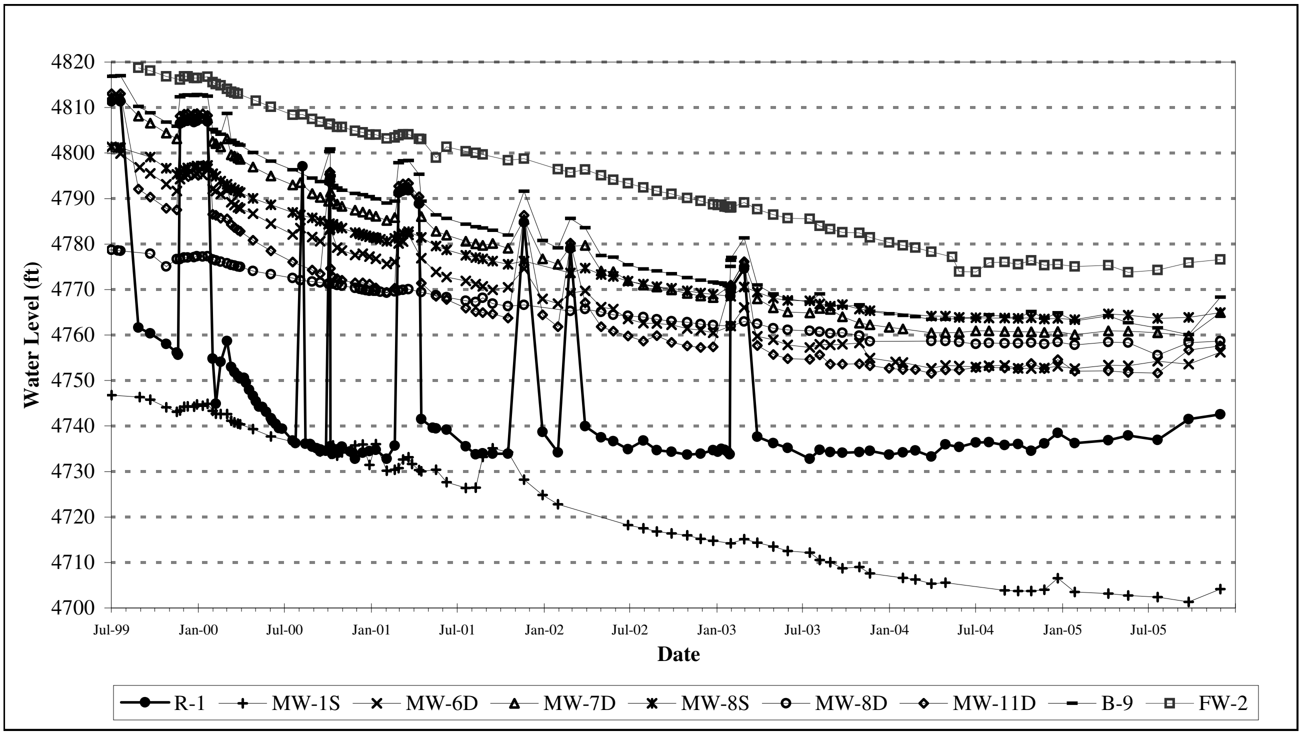


Figure 5-10: R-2 Hydrographs

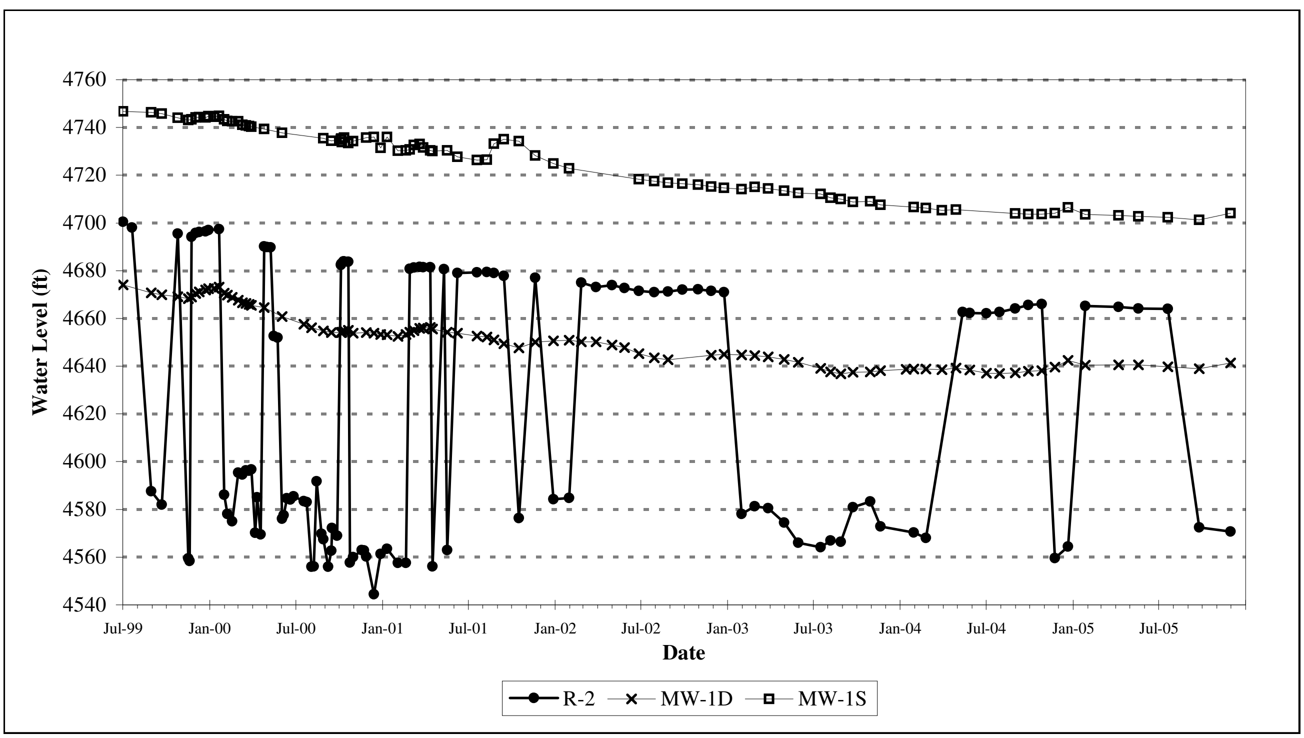
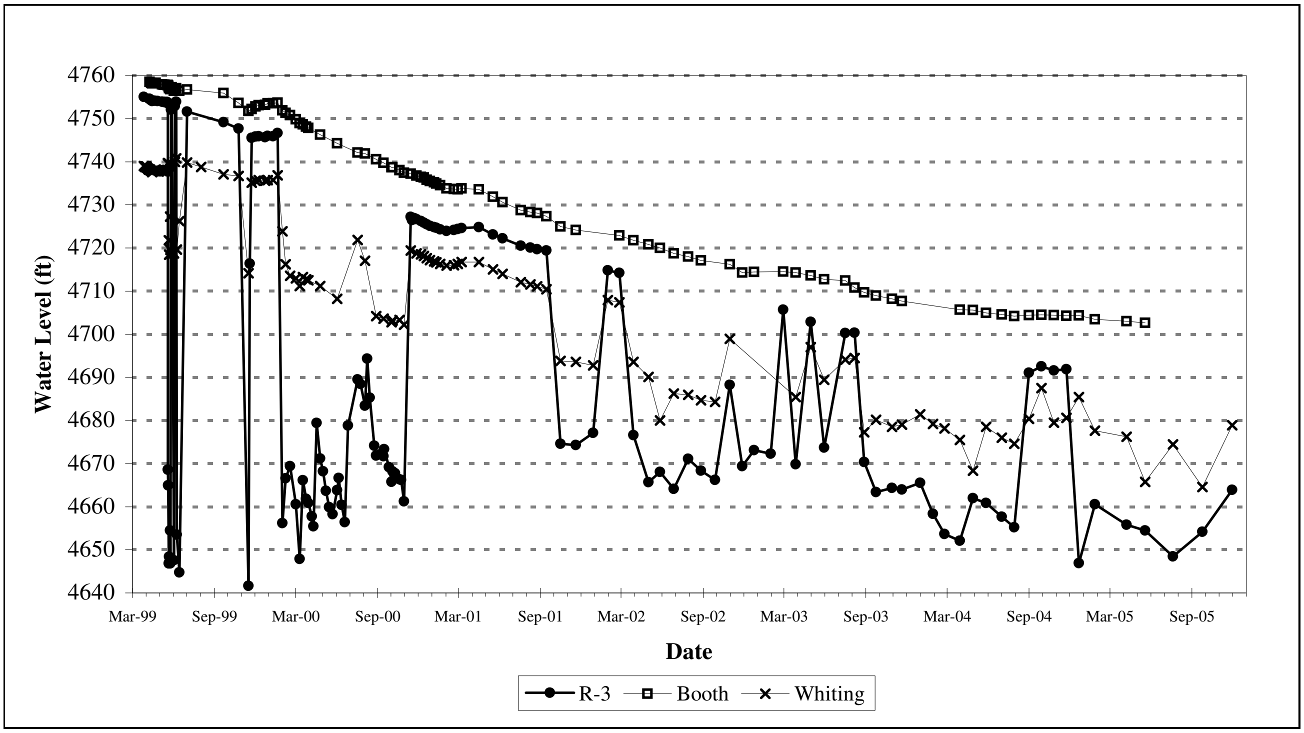


Figure 5-11: R-3 Hydrographs



Concentration trend charts for each of the recovery wells and selected observation wells are provided and discussed below. Water quality data from the third quarter of 1995 through the fourth quarter of 2005 have been included in these charts. The third quarter of 1995 was selected as a starting point because that is when consistent sampling for CEMs began and it offers sufficient pre-pumping data to assess if pumping has affected apparent changes in solute concentration trends in selected observation wells. Charts have been prepared for nitrate-nitrogen, RDX and total specialty nitrate esters (TSNE). Charts for HMX were not prepared due to its relatively limited distribution and low concentrations. The vertical dashed line in each chart indicates the approximate start of pumping for each recovery well. The statistical significance of the concentration trends was evaluated using the Mann-Kendall Trend Test as described previously in this document.

5.2.4.1 Mapleton No. 1

Figure 5-12 presents concentration trend charts for Mapleton No. 1 and MW-3D.

Nitrate-nitrogen concentrations in Mapleton No. 1 exhibit a statistically significant downward trend. There is no trend in nitrate-nitrogen concentrations at MW-3D.

No trend in RDX concentrations is observed in Mapleton No. 1. A statistically significant upward RDX concentration trend is present in MW-3D.

In contrast to the end of 2002 when there was no trend in TSNE concentrations in Mapleton No. 1 the TSNE concentrations in Mapleton No.1 continue to show a statistically significant downward trend through 2005. For the first time a slight downward trend in TSNE concentrations are observed at MW-3D where no trend was present before.

5.2.4.2 Orton-23

Figure 5-13 presents concentration trend charts for Orton-23, MW-10D, Young and Bluth.

Nitrate-nitrogen concentrations in Orton-23 have a downward trend, although it is not readily apparent if the decreasing trend is in response to pumping. A downward trend is observed at Young. No trends in nitrate-nitrogen concentrations are observed at MW-10D and Bluth. Prior to 2005, MW-10D exhibited an increasing nitrate-nitrogen trend.

RDX concentrations in Orton-23 exhibit a downward trend. A Statistically significant increasing RDX concentration trend is observed in MW-10D. There are no trends in RDX concentrations at Bluth and Young. These trends are consistent with what was observed at the end of 2004.

A statistically significant downward TSNE concentration trend is observed in Orton-23. A downward trend is also observed in TSNE concentration at Young. No trends in TSNE concentrations are present in MW-10D or Bluth. These trends are consistent with what was observed at the end of 2004.

5.2.4.3 R-1

Figure 5-14 presents concentration trend charts for R-1, MW-6D, MW-7D and MW-11D.

Statistically significant downward trends in nitrate-nitrogen concentrations are present in R-1, MW-6D, MW-7D and MW-11D. Long-term declining concentrations in MW-6D, MW-7D and MW-11D appear to be tailing off. These trends are consistent with what was observed at the end of 2004.

Statistically significant downward trends in RDX concentrations are present in R-1, MW-6D, MW-7D and MW-11D. No trend was previously present at MW-7D. Long-term declining trends are apparent in each of the observation wells. However, at MW-11D an apparent acceleration in the rate of decline in RDX concentrations is observed after pumping began. With the exception of MW-7D, these trends are consistent with what was observed at the end of 2004.

Statistically significant downward TSNE concentration trends are observed in R-1, MW-6D, MW-7D and MW-11D. These trends are consistent with what was observed at the end of 2004.

5.2.4.4 R-2

Figure 5-15 presents concentration trend charts for R-2, MW-1S, MW-1D and UP&L.

Statistically significant downward nitrate-nitrogen concentration trends are observed in R-2, MW-1S, MW-1D and UP&L. Coincident with the restarting of the R-2 well after periods of inactivity, nitrate-nitrogen concentrations in R-2 rise from approximately 5 mg/L to 10 mg/L. Even with this rise in nitrate-nitrogen concentrations, the overall trend at R-2 is downward.

RDX first appeared in R-2 in early 2002 prior to the one year shutdown of this well and was not detected again until the well was placed back into continuous operation in March 2003. During 2004, RDX was detected in R-2 during four of six sampling events at concentrations of $\leq$1.5 µg/L. Sufficient detections are available to establish a statistically significant increasing trend. Declining trends are observed at MW-1S, MW-1D and UP&L. MW-1D first showed a declining trend in 2003, UP&L in 2004 and MW-1S in 2005.

EGDN is the only specialty nitrate detected in R-2. Prior to 2002, the concentration of EGDN in R-2 was relatively steady at about 6 µg/L with no trend. A statistically significant declining trend was first observed in 2002 and continues through 2005. As observed at the end of 2004, statistically significant downward TSNE concentration trends are present in MW-1S and UP&L and no trend is present at MW-1D.

5.2.4.5 R-3

Figure 5-16 presents concentration trend charts for R-3 and Whiting.

Nitrate-nitrogen concentrations in R-3 exhibit a statistically significant decreasing trend. A similar long-term decreasing trend is observed in Whiting before and after pumping.

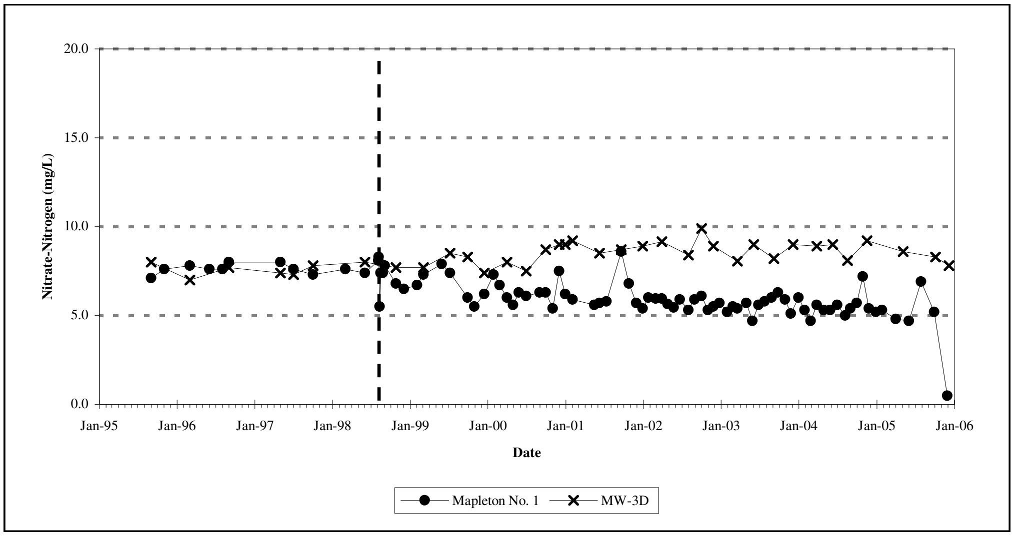
A statistically significant downward RDX concentration trend was observed in R-3. RDX concentrations in R-3 declined sharply from a high of approximately 20 µg/L to 10 µg/L between 1999 and 2004 and have been just below 10 µg/L through 2005. Over the same time period at Whiting, no trend in RDX concentration is present and substantial variability is observed in concentration between sampling events.

As observed at the end of 2004, statistically significant downward TSNE concentration trends are observed in both R-3 and Whiting.

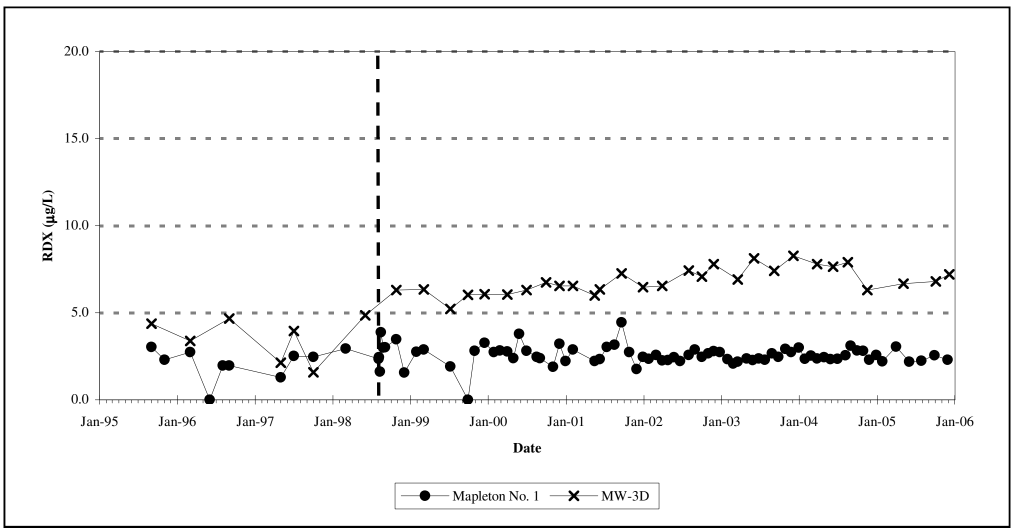
5.2.5 Annual Recovery System Performance

Table 5-2 presents estimates of annual average recovery system performance based on actual volumes extracted and average constituent concentrations from extraction wells during 2005. Nitrate, RDX and total specialty nitrate esters (a combination of EGDN, DEGDN, TEGDN, TMETN, BTTN, PETN) concentrations were used for this assessment. Orton-23 and Mapleton No.1 account for approximately 83% of the volume of ground water extracted during 2005. R-1 accounts for about 13% of the annual volume and R-2 and R-3 combine for the remaining 4%. These percentages are nearly the same as observed for 2004. Based on a percentage of approximate annual constituent mass recovery, Orton-23 provided 33% of the total mass recovery for nitrate; 47% of RDX; and, 45% of total specialty nitrate esters during 2005. These percentages are approximately 10% to 15% higher than observed for 2004. The total mass removed from Orton-23 has declined considerably compared to the values presented in the CAP due to the reduction in flow rate from the Orton-23 well in response to changing water level conditions. During 2005, Mapleton No. 1 provided 55% of the total mass recovery of nitrate; 25% of RDX; and, 37% of total specialty nitrate esters. These percentages are approximately 3% to 10% lower than observed for 2004. During 2005, R-1 recovered approximately 10% of the total mass recovery of nitrate; 22% of RDX; and, 13% for total specialty nitrate esters. These percentages are approximately 2% to 8% lower than observed in 2004. As was observed in 2004, R-2 and R-3 combined account for approximately 3 to 5% of the annual mass recovery of nitrate, RDX and total specialty nitrate esters.

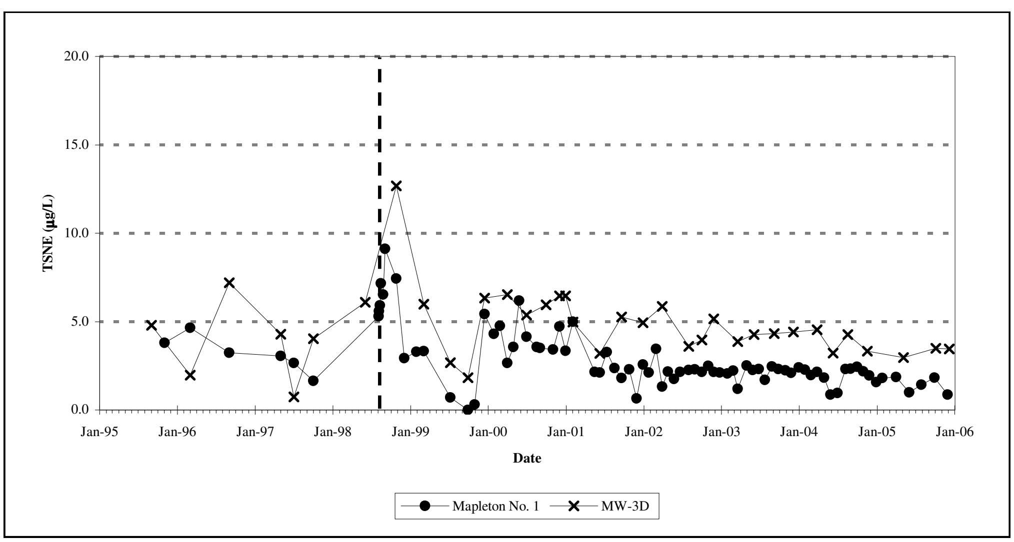
Figure 5-12: Mapleton No. 1 and Selected Observation Wells - COC Trends



Nitrate-nitrogen

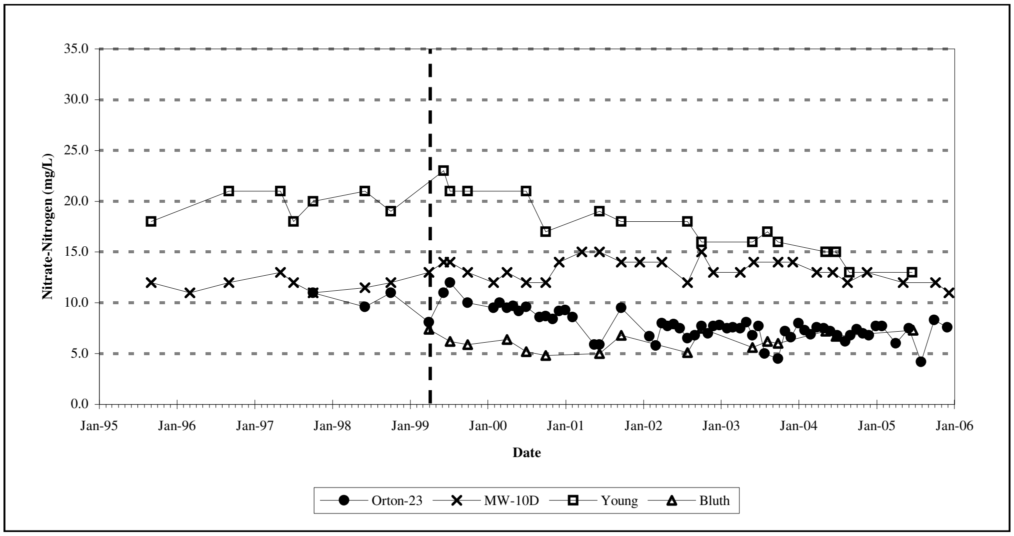


RDX

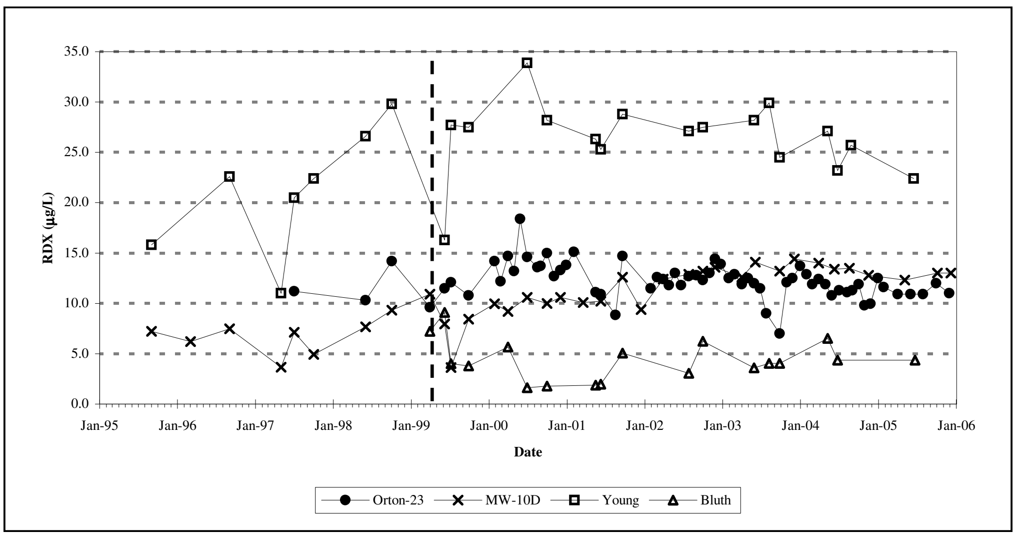


TSNE

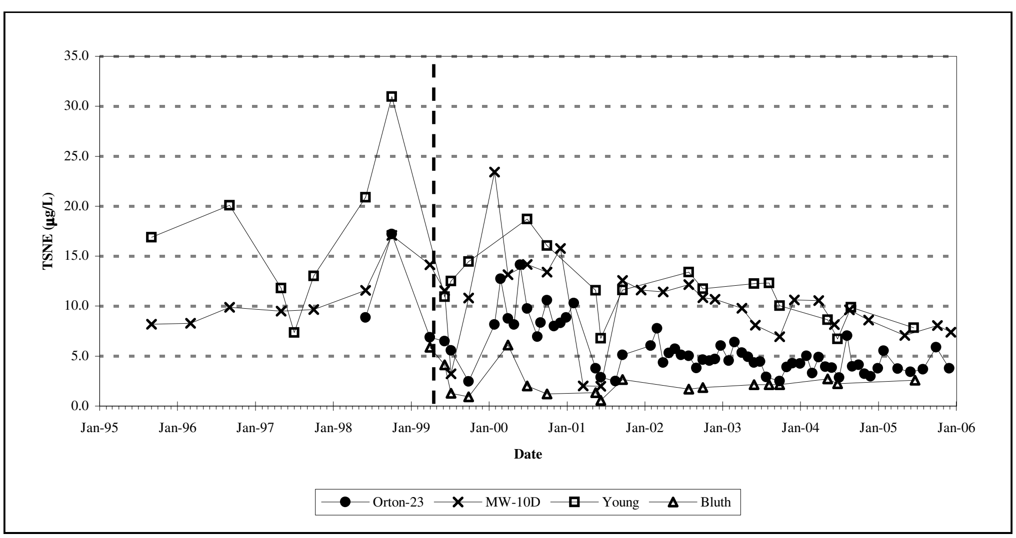
Figure 5-13: Orton-23 and Selected Observation Wells - COC Trends



Nitrate-nitrogen

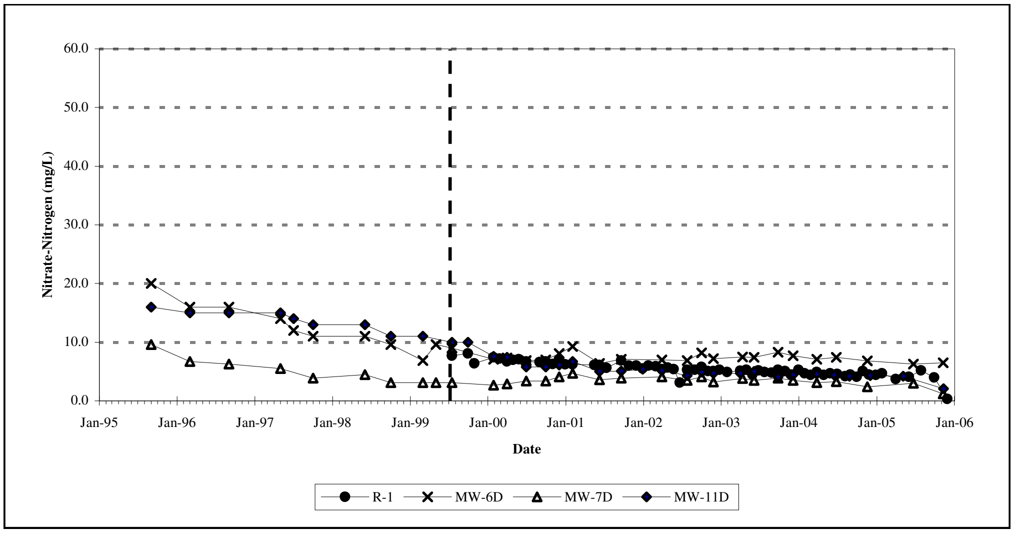


RDX

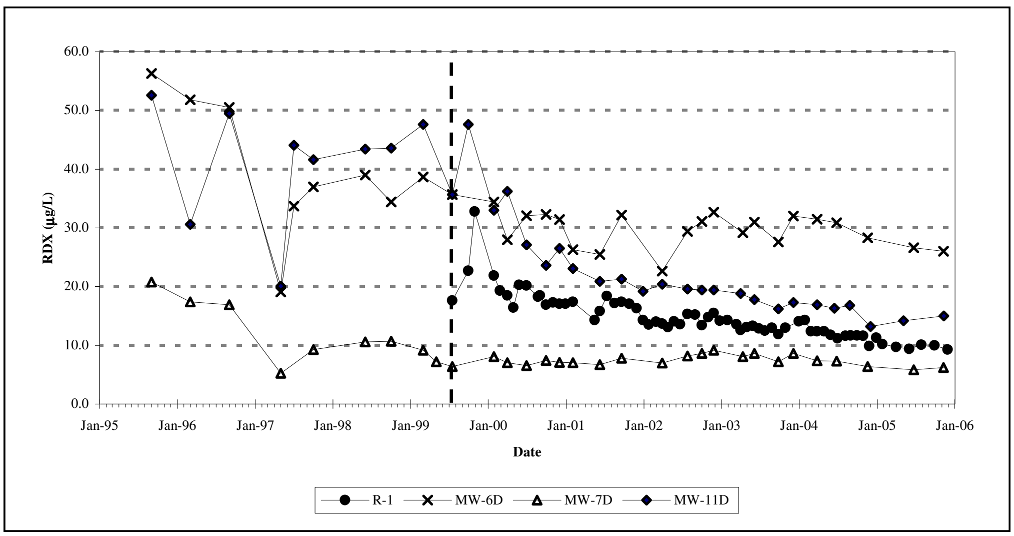


TSNE

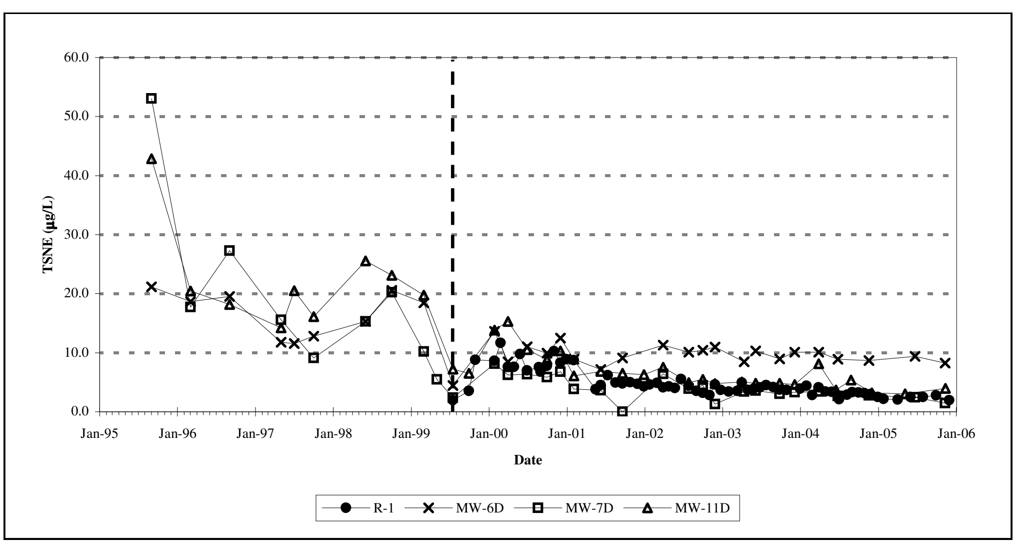
Figure 5-14: R-1 and Selected Observation Wells - COC Trends



Nitrate-nitrogen

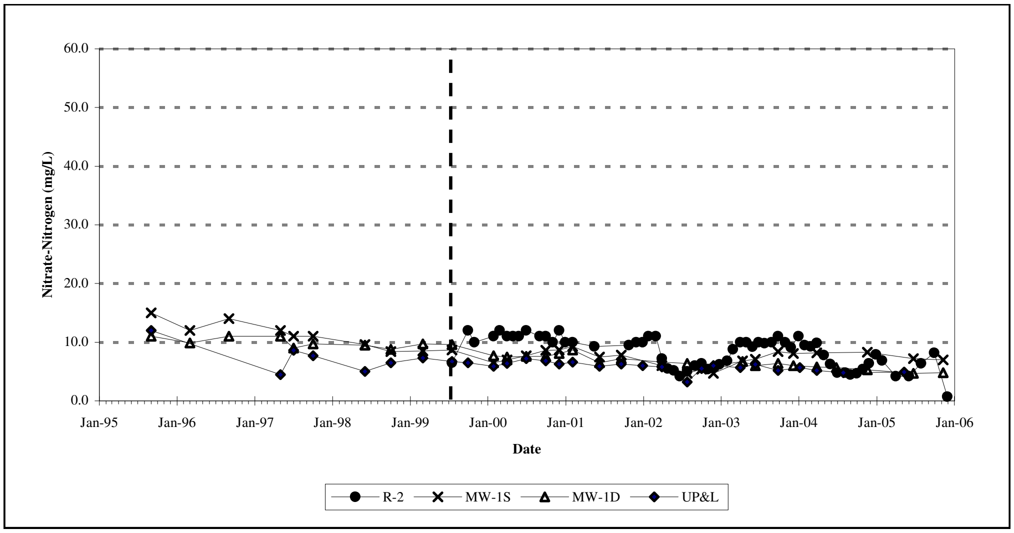


RDX

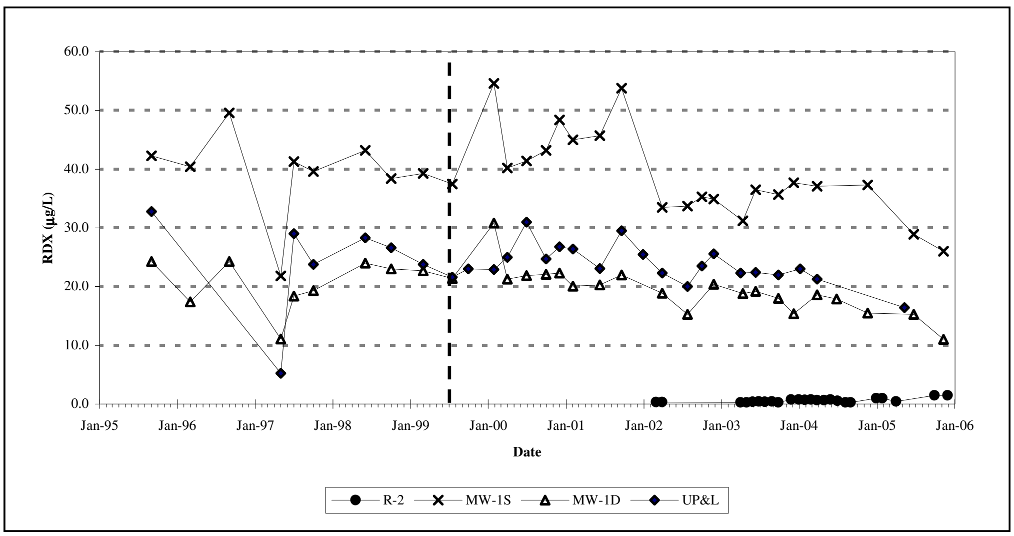


TSNE

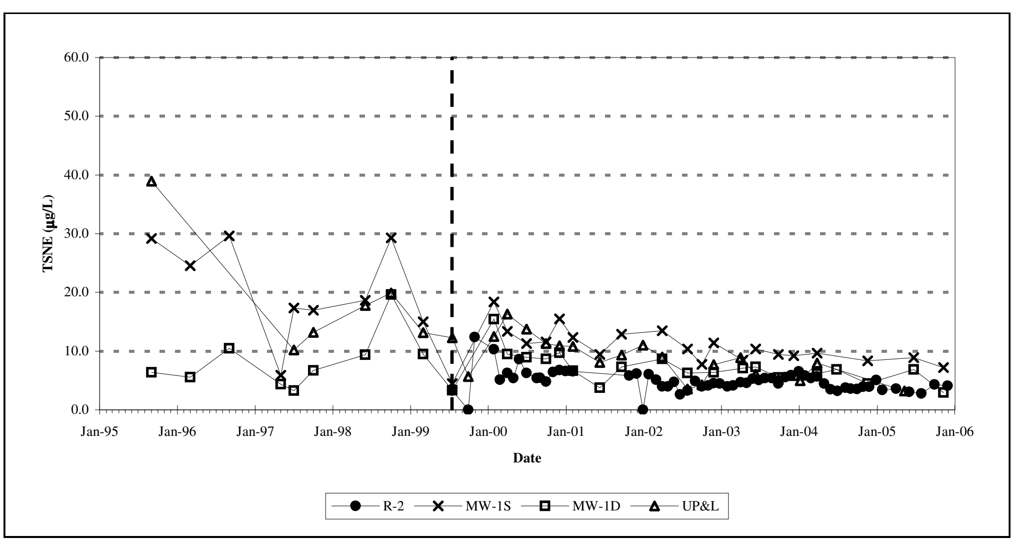
Figure 5-15: R-2 and Selected Observation Wells - COC Trends



Nitrate-nitrogen

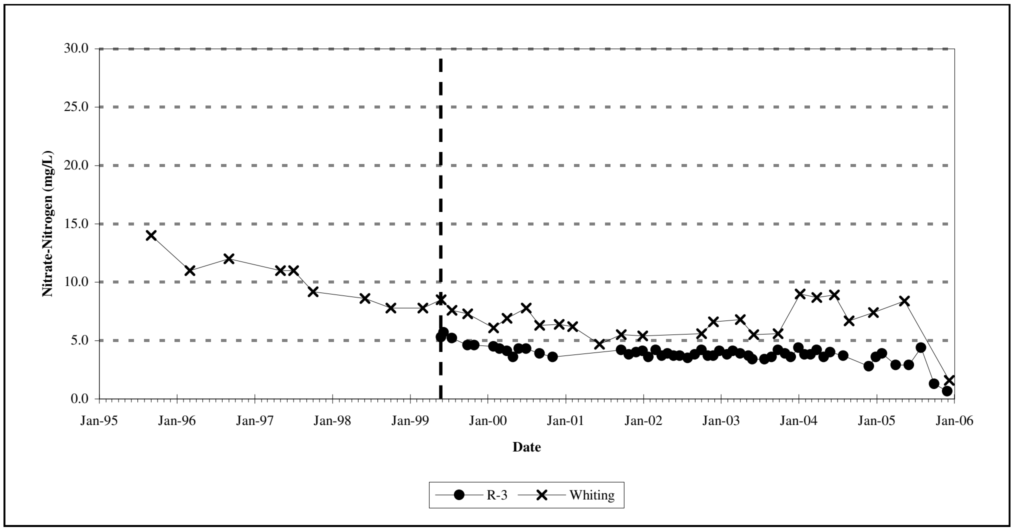


RDX

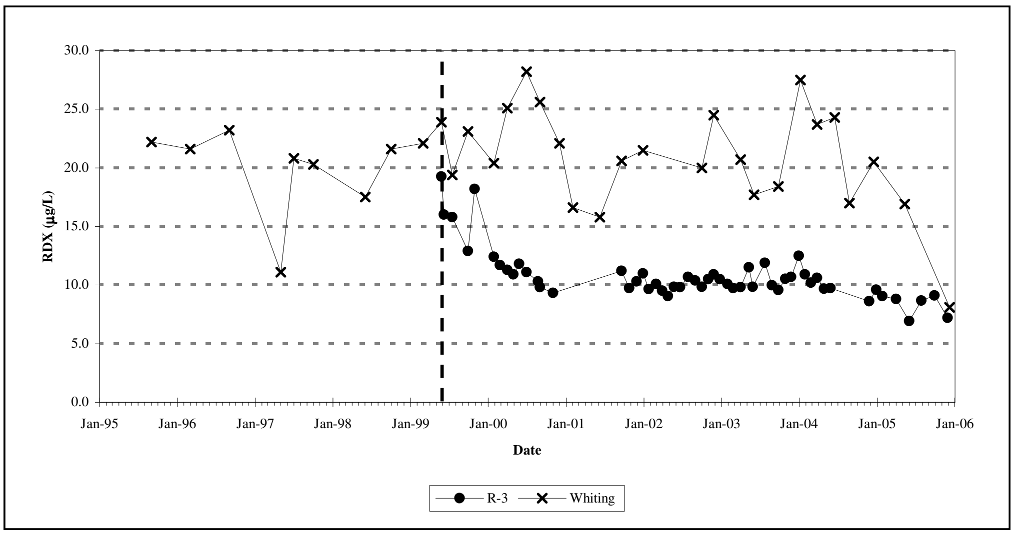


TSNE

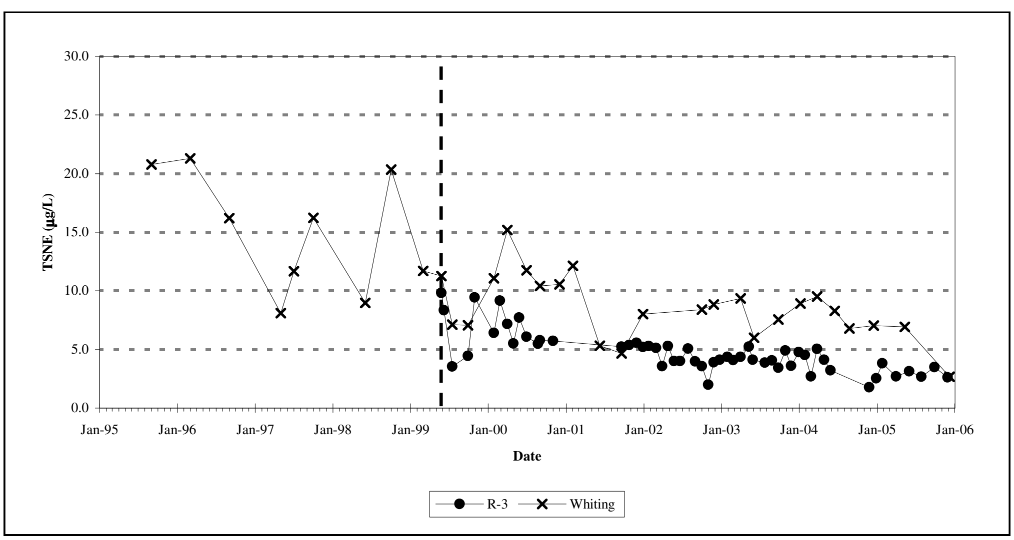
Figure 5-16: R-3 and Selected Observation Wells - COC Trends



Nitrate-nitrogen



RDX



TSNE

Because the forgoing analysis is subject to bias due to the volume of water extracted, it is illuminating to look at the percentage of mass removed normalized to a fixed volume of water extracted. This type of analysis provides insight into the relative efficiency of constituent removal. Table 5-3 provides a summary of percentage of mass of solutes removed per each 100,000 gallons pumped during 2005. Recovery wells R-2 and R-3, which have the lowest flow rates and therefore the lowest percentage of solute removal on an annual volume basis, generally have solute removal efficiencies that are similar to the other higher volume wells. Conversely, the solute removal efficiency of Mapleton No. 1 is relatively lower when compared to the other recovery wells, reflecting the lower concentrations of CEMs in Mapleton No. 1.

When evaluating these data, Tables 5-2 and 5-3 should be considered together. Considering both flow rate and removal efficiency, R-1 and Orton-23 continue to be the best performing wells for solute recovery and R-2 and R-3 exhibit the lowest solute recovery performance. Although concentrations at Mapleton No. 1 well remain low, the operation of this well at relatively high flow rates continues to remove a substantial mass of solutes from the regional aquifer and restores a valuable resource to beneficial use.

5.2.6 Estimated Time to Achieve Proposed CACLs and Interim Water Quality Goals

Concentrations of the specialty nitrate esters (individually or combined) and HMX are below the proposed CACLs at all monitoring locations within the regional aquifer. Concentrations of specialty nitrate esters and HMX are not expected to exceed the proposed CACLs at any time in the future.

Conditions which influence time estimates to achieve proposed CACLs for the remaining COCs or the interim ground water quality goal for RDX include:

- Heterogeneity of the regional unconsolidated aquifer;
- The unquantified effects of rewetting of unsaturated deposits;
- The unquantified degree to which diffusion of solutes into fine-grained deposits may act as continuing sources of solutes to the more permeable aquifer materials; and,
- The unquantified degree to which the sorption of certain CEMs will affect long-term water quality in the regional aquifer

Ongoing data collection and analysis will provide additional data that may be used to address the uncertainties identified above. Notwithstanding the forgoing and based on the information presented in Section 4, declining constituent concentration trends are observed at the majority of monitoring locations throughout the study area.

Table 5-2: 2005 Annual Average Recovery System Performance Evaluation

Well	Total Volume Recovered (gal)	Relative Volume Percentage	Ave NO_3-N (mg/L)	Total NO_3-N (lb)	Percentage NO_3-N Recovery	Ave RDX (µg/L)	Total RDX (lb)	Percentage RDX Recovery	Ave TSNE (µg/L)	Total TSNE (lb)	Percentage TSNE Recovery
R-1	97,253,449	13%	3.67	2,972	10%	9.78	8	22%	2.32	1.9	13%
R-2	5,369,551	0.7%	5.10	228	0.7%	1.10	0.05	0.1%	3.53	0.2	1%
R-3	23,529,733	3%	2.68	524	2%	8.29	2	5%	3.07	0.6	4%
Orton-23	179,138,096	24%	6.88	10,268	33%	11.22	17	47%	4.34	6.5	45%
No. 1	443,476,154	59%	4.65	17,185	55%	2.42	9	25%	1.45	5.3	37%
TOTALS	**748,766,983**	**100%**		**31,177**	**100%**		**35**	**100%**		**14**	**100%**

ND = Not Detected

Table 5-3
Recovery Well Solute Removal Efficiency
Mass Removed Per 100,000 Gallons Extracted

Well	Total NO_3-N (lb)	Relative Percentage NO_3-N	Total RDX (lb)	Relative Percentage RDX	Total TNSE (lb)	Relative Percentage TNSE
R-1	3.1	16%	0.008	30%	0.002	16%
R-2	4.2	22%	0.001	3%	0.003	24%
R-3	2.2	12%	0.007	25%	0.003	21%
Orton-23	5.7	30%	0.009	34%	0.004	29%
No. 1	3.9	20%	0.002	7%	0.001	10%
Totals	**19.1**	**100%**	**0.027**	**100%**	**0.012**	**100%**

6.0 GRANULAR ACTIVATED CARBON TREATMENT SYSTEMS

Three nearly identical granular activated carbon (GAC) treatment facilities have been installed in the project area: Mapleton GAC, Orton GAC and Spanish Fork GAC. Their locations are presented in Figure 5-1. The three systems were fabricated and installed by Northwest Carbon (now US Filter/Westates) of Red Bluff, California. Each GAC treatment system consists of two treatment columns, each containing 20,000 pounds of carbon. The treatment columns are operated in series so that there is a lead and a lag column in each treatment system. The lead and lag columns in each treatment system vary based on the timing of the most recent carbon exchange event.

As described in the CAP, expended carbon is regenerated by US Filter/Westates in accordance with the criteria established by the Utah Division of Drinking Water for the use of regenerated carbon in public water supply systems. Regenerated carbon from the project is used interchangeably amongst the three treatment systems. EBCo maintains seven batches of carbon for use on this project (six treatment columns plus one extra).

Further details regarding the design, operation and monitoring of the GAC treatment systems are presented in the CAP and the Mapleton GAC O&M Manual and the Spanish Fork GAC O&M Manual (Charter Oak, revised April 2002) and are not repeated herein.

6.1 GAC Performance Monitoring

Water samples are collected on a monthly frequency from each GAC treatment system to monitor carbon loading. Water from each treatment column can be sampled at five locations (influent, 25%, 50%, 75% and effluent). Samples are collected from the treatment system influent (untreated water), treatment system effluent (fully treated water) and from two or three intermediate sample ports within the lead and/or lag columns. The intermediate sample ports are selected based on professional judgment and review of prior data. Tables 6-1, 6-2 and 6-3 present summaries of GAC treatment system performance monitoring data for the treated discharges from the Mapleton, Orton and Spanish Fork treatment systems during 2005. A concentration of 0.39 µg/L EGDN was reported as detected in the discharge from the Mapleton in September 2005. This concentration is slightly above the minimum detection limit of 0.34 µg/L and well below the proposed CACL of 52 µg/L. EGDN was not detected during the October sampling event which was completed just prior to the exchange of carbon in the lead column. There was no breakthrough of CEMs in the Orton or Spanish Fork GAC treatment systems during 2005.

6.1.1 Carbon Exchange

When carbon performance data indicates that the carbon in a particular column is loaded (always the lead column of each treatment system), US Filter/Westates is contacted and a carbon exchange is scheduled. Expended carbon from the lead column is removed and

Table 6-1: Mapleton GAC Treated Water Quality Data Summary
January 2005 through December 2005

Date	HMX (µg/L)	RDX (µg/L)	EGDN (µg/L)	DEGDN (µg/L)	TEGDN (µg/L)	NG (µg/L)	2,4,6 TNT (µg/L)	BTTN (µg/L)	2,6 DNT (µg/L)	2,4-DNT (µg/L)	TMETN (µg/L)	PETN (µg/L)
1/25/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
2/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
3/31/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
4/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
5/31/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
6/30/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
7/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
8/30/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
9/27/2005	<0.22	<0.21	**0.39**	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
10/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
11/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
12/28/2004	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32

Samples collected from the final treated discharge from the GAC treatment system

Table 6-2: Orton GAC Treated Water Quality Data Summary
January 2005 through December 2005

Date	HMX (µg/L)	RDX (µg/L)	EGDN (µg/L)	DEGDN (µg/L)	TEGDN (µg/L)	NG (µg/L)	2,4,6 TNT (µg/L)	BTTN (µg/L)	2,6 DNT (µg/L)	2,4-DNT (µg/L)	TMETN (µg/L)	PETN (µg/L)
1/25/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
2/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
3/31/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
4/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
5/31/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
6/30/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
7/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
8/30/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
9/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
10/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
11/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
12/28/2004	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32

Samples collected from the final treated discharge from the GAC treatment system

Table 6-3: Spanish Fork GAC Treated Water Quality Data Summary
January 2005 through December 2005

Date	HMX (µg/L)	RDX (µg/L)	EGDN (µg/L)	DEGDN (µg/L)	TEGDN (µg/L)	NG (µg/L)	2,4,6 TNT (µg/L)	BTTN (µg/L)	2,6 DNT (µg/L)	2,4-DNT (µg/L)	TMETN (µg/L)	PETN (µg/L)
1/25/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
2/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
3/31/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
4/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
5/31/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
6/30/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
7/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
8/30/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
9/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
10/27/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
11/28/2005	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32
12/28/2004	<0.22	<0.21	<0.34	<0.47	<0.17	<0.10	<0.16	<0.23	<0.18	<0.16	<0.23	<0.32

Samples collected from the final treated discharge from the GAC treatment system replaced with regenerated or virgin carbon. The former lag column is then placed in the lead position. A total of four carbon exchanges occurred during 2005. Both columns of the Mapleton GAC treatment system were exchanged and one column from both the Orton GAC treatment system and the Spanish Fork GAC treatment system were exchanged. Table 6-4 tracks the regeneration and installation history of each of the seven batches of activated carbon used for this project.

Approximately 8,000 – 16,000 gallons of water discharges are produced during each carbon exchange event. This water is derived from the slurry transfer process used to remove and install the carbon in each treatment vessel and from a short duration backwashing operation that expands and settles the carbon once placed in the treatment vessel. The water is discharged to the Spanish Fork Publicly Owned Treatment Works (POTW) via either Mapleton or Spanish Fork sewerage conveyance lines. The water discharge is sampled for CEMs, nitrate and total suspended solids (TSS) and Charter Oak maintains these data for future reference. The supervisor of the Spanish Fork POTW is notified in advance of each carbon exchange event.

Table 6-4: Ground Water Recovery Treatment Systems - Granular Activated Carbon Tracking Log

GAC BATCH NO.	ORIGINAL LOCATION	LOCATION NO. 1	LOCATION NO. 2	LOCATION NO. 3	LOCATION NO. 4	LOCATION NO. 5
EBCO-GAC-B1	Mapleton GAC Column 1 Date Installed: 28-Jul-98 Date Removed: 14-Apr-99 Volume: 20,000 lbs Virgin Iodine #: 900 (min)	Location Installed: Mapleton GAC Column 2 Reactivation Date: 20-Apr-99 Installation Date: 14-Apr-00 React. Iodine #: 945 Recovered GAC: 14,507 lbs Added Virgin GAC: 5,493 lbs Date Removed: 6-Mar-01	Location Installed: Spanish Fork GAC Column 1 Reactivation Date: 13-Mar-01 Installation Date: 20-Mar-01 React. Iodine #: 948 Recovered GAC: 18,000 lbs Added Virgin GAC: 2,000 lbs Date Removed: 30-Jul-02	Location Installed: Mapleton GAC Column 1 Reactivation Date: NA - Replaced w/ 100% Virgin Installation Date: 16-Apr-03 React. Iodine #: 900(min) Recovered GAC: 0 lbs Added Virgin GAC: 20,000 lbs Date Removed: 24-Mar-04	Location Installed: Mapleton GAC Column 2 Reactivation Date: 4-Apr-04 Installation Date: 24-Aug-04 React. Iodine #: 965 Recovered GAC: 16,368 lbs Added Virgin GAC: 3,632 lbs Date Removed: 2-Nov-05	Location Installed: STORAGE @ USFILTER Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:
EBCO-GAC-B2	Mapleton GAC Column 2 Date Installed: 28-Jul-98 Date Removed: 14-Apr-00 Volume: 20,000 lbs Virgin Iodine #: 900 (min)	Location Installed: Orton GAC Column 1 Reactivation Date: 18-Apr-00 Installation Date: 26-Apr-00 React. Iodine #: 872 Recovered GAC: 16,700 lbs Added Virgin GAC: 3,300 lbs Date Removed: 21-Feb-01	Location Installed: Mapleton GAC Column 2 Reactivation Date: 2-Mar-01 Installation Date: 6-Mar-01 React. Iodine #: 920 Recovered GAC: 17,000 lbs Added Virgin GAC: 3,000 lbs Date Removed: 16-Jul-02	Location Installed: Spanish Fork GAC Column 1 Reactivation Date: 27-Jul-02 Installation Date: 30-Jul-02 React. Iodine #: 893 Recovered GAC: 13,000 lbs Added Virgin GAC: 7,000 lbs Date Removed: 12-May-05	Location Installed: Orton GAC Column 2 Reactivation Date: 4-Jun-05 Installation Date: 22-Jun-05 React. Iodine #: 788 Recovered GAC: 18,059 lbs Added Virgin GAC: 1,941 lbs Date Removed: NA	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:
EBCO-GAC-B3	Orton GAC Column 1 Date Installed: 25-Mar-99 Date Removed: 26-Apr-00 Volume: 20,000 lbs Virgin Iodine #: 900 (min)	Location Installed: Mapleton GAC Column 1 Reactivation Date: 3-May-00 Installation Date: 1-Jun-00 React. Iodine #: 999 Recovered GAC: 16,700 lbs Added Virgin GAC: 3,300 lbs Date Removed: 3-Apr-01	Location Installed: Spanish Fork GAC Column 2 Reactivation Date: 20-Apr-01 Installation Date: 24-Apr-01 React. Iodine #: 896 Recovered GAC: 17,800 lbs Added Virgin GAC: 2,200 lbs Date Removed: 29-Sep-03	Location Installed: Mapleton GAC Column 2 Reactivation Date: NA - Replaced w/ 100% Virgin Installation Date: 15-Oct-03 React. Iodine #: 900(min) Recovered GAC: 0 lbs Added Virgin GAC: 20,000 lbs Date Removed: 24-Aug-04	Location Installed: Orton GAC Column 1 Reactivation Date: 3-Sep-04 Installation Date: 23-Sep-04 React. Iodine #: 938 Recovered GAC: 16,005 lbs Added Virgin GAC: 3,995 lbs Date Removed: NA	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:
EBCO-GAC-B4	Orton GAC Column 2 Date Installed: 25-Mar-99 Date Removed: 12-Jun-00 Volume: 20,000 lbs Virgin Iodine #: 900 (min)	Location Installed: Orton GAC Column 1 Reactivation Date: 28-Jun-00 Installation Date: 21-Feb-01 React. Iodine #: 920 Recovered GAC: 15,950 lbs Added Virgin GAC: 4,050 lbs Date Removed: 7-May-02	Location Installed: Mapleton GAC Column 2 Reactivation Date: 8-May-02 Installation Date: 16-Jul-02 React. Iodine #: 879 Recovered GAC: 18,000 lbs Added Virgin GAC: 2,000 lbs Date Removed: 15-Oct-03	Location Installed: Mapleton GAC Column 1 Reactivation Date: 19-Oct-03 Installation Date: 24-Mar-04 React. Iodine #: 849 Recovered GAC: 18,000 lbs Added Virgin GAC: 2,000 lbs Date Removed: 15-Mar-05	Location Installed: Spanish Fork GAC Column 1 Reactivation Date: 16-Mar-05 Installation Date: 12-May-05 React. Iodine #: 807 Recovered GAC: 17,823 lbs Added Virgin GAC: 3,077 lbs Date Removed: NA	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:
EBCO-GAC-B5	Spanish Fork GAC Column 1 Date Installed: 6-Jul-99 Date Removed: 20-Mar-01 Volume: 20,000 lbs Virgin Iodine #: 900 (min)	Location Installed: Mapleton GAC Column 1 Reactivation Date: 23-Mar-01 Installation Date: 3-Apr-01 React. Iodine #: 911 Recovered GAC: 17,000 lbs Added Virgin GAC: 3,000 lbs Date Removed: 10-Apr-02	Location Installed: Orton GAC Column 1 Reactivation Date: 24-Apr-02 Installation Date: 7-May-02 React. Iodine #: 907 Recovered GAC: 14,300 lbs Added Virgin GAC: 5,700 lbs Date Removed: 23-Sep-04	Location Installed: Mapleton GAC Column 1 Reactivation Date: 14-Oct-04 Installation Date: 15-Mar-05 React. Iodine #: >850 Recovered GAC: 13,058 lbs Added Virgin GAC: 6,600 lbs Date Removed: NA	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:
EBCO-GAC-B6	Spanish Fork GAC Column 2 Date Installed: 6-Jul-99 Date Removed: NA Volume: 20,000 lbs Virgin Iodine #: 900 (min)	Location Installed: Orton GAC Column 2 Reactivation Date: 26-Apr-01 Installation Date: 8-May-01 React. Iodine #: 950 Recovered GAC: 18,000 lbs Added Virgin GAC: 2,000 lbs Date Removed: 7-May-03	Location Installed: Spanish Fork GAC Column 2 Reactivation Date: 25-Jul-03 Installation Date: 29-Sep-03 React. Iodine #: 788 Recovered GAC: 16,000 lbs Added Virgin GAC: 4,000 lbs Date Removed: NA	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:
EBCO-GAC-B7	Mapleton GAC Column 1 (First GAC Exchange-Virgin GAC) Date Installed: 14-Apr-99 Date Removed: 1-Jun-00 Volume: 20,000 lbs Virgin Iodine #: 900 (min)	Location Installed: Orton GAC Column 2 Reactivation Date: 7-Jun-00 Installation Date: 12-Jun-00 React. Iodine #: 871 Recovered GAC: 16,921 lbs Added Virgin GAC: 3,079 lbs Date Removed: 8-May-01	Location Installed: Mapleton GAC Column 1 Reactivation Date: 14-May-01 Installation Date: 10-Apr-02 React. Iodine #: 870 Recovered GAC: 15,000 lbs Added Virgin GAC: 5,000 lbs Date Removed: 16-Apr-03	Location Installed: Orton GAC Column 2 Reactivation Date: 19-Apr-03 Installation Date: 7-May-03 React. Iodine #: 864 Recovered GAC: 15,257 lbs Added Virgin GAC: 4,400 lbs Date Removed: 22-Jun-05	Location Installed: Mapleton GAC Column 2 Reactivation Date: 4-Jun-05 Installation Date: 2-Nov-05 React. Iodine #: 833 (avg) Recovered GAC: 17,000 lbs Added Virgin GAC: 3,000 lbs Date Removed: NA	Location Installed: Reactivation Date: Installation Date: React. Iodine #: Recovered GAC: lbs Added Virgin GAC: lbs Date Removed:

NOTES:
1. GAC reactivation provided by USFilter Westates, Red Bluff, CA
2. GAC batches installed in Mapleton GAC Column 1 and Column 2 require that a Carbon Reactivation Reporting Form be filed with the Utah Division of Drinking Water.

7.0 UPDES PERMITS

EBCo maintains two UDPES Permits for the discharge of treated water to surface streams. Permit UT0025725 regulates treated ground water discharges into the Spanish Fork River and Permit UT0025283 regulates treated ground water discharges into Hobble Creek.

UPDES Permit UT0025283 (Hobble Creek) was renewed on January 1, 2003. This renewed Permit is effective for five years.

UPDES Permit UT0025275 (Spanish Fork) was renewed on June 1, 2004. This renewed Permit is effective for five years. This renewed Permit added annual metals testing, analyzing for aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc. The renewed Permit also changed the monitoring location to the discharge point from the GAC treatment system, reduced the monitoring requirements for dissolved oxygen (DO) to the non-irrigation season only (November through March) and established a revised DO effluent limit of 4.0 mg/L.

During 2005, monitoring parameters were within Permit-specified effluent limits at both discharges.

8.0 INSTITUTIONAL CONTROLS – ANNUAL ASSESSMENT

8.1 Institutional Controls

8.1.1 Private and Municipal Well Sampling and Reporting

Upon the receipt and review of water quality sampling results, EBCo provides water quality data summaries to Mapleton City, Spanish Fork City and individual private well owners whose wells are included in the ground water monitoring program. Analytical results have been provided to private and municipal well owners whose wells were sampled in 2005. Copies of these letters are provided to DWQ and the Utah County Health Department.

8.1.2 Annual Review of Water Rights Records

Water rights records for the project study area, available on-line from the Utah Division of Water Rights (DWR), were reviewed in 2005. These records are compared with an existing water rights database to identify potential new well owners in the study area. If new well owners are identified in areas of known ground water impacts EBCo will notify them of known or suspected water quality conditions in their well.

No new perfected water rights were identified in 2005 that indicated new well locations within areas of known or suspected ground water impacts.

8.1.3 DWR Limitations on Water Right Transfers

In accordance with the Utah/Goshen Valley Ground Water Management Plan (DWR, 1995) a “restricted area” in the study area has been established by DWR. According to the management plan, DWR should not grant new change applications, which propose to transfer water rights into this area. However, DWR may approve change applications that are filed on water rights that previously existed in this area and that do not transfer additional water rights into the “restricted area”. The Utah/Goshen Valley Ground Water Management Plan was not revised during 2005 and the “restricted area” remains as is defined in that document.

8.1.4 Mapleton City Building Permit Ordinance

An ordinance established in Mapleton City’s municipal code does not allow issuance of building permits without a municipal water connection. This ordinance ensures that new homes/businesses will not rely solely on a private well for potable water. Mapleton City’s ordinance regarding municipal water connections for homes and businesses remains in effect. EBCo does not participate in Mapleton City's enforcement of this ordinance.

9.0 RECOMMENDATIONS

9.1 Extraction Well Installation

No additional extraction wells are proposed at this time.

9.2 Extraction Well Operations

It is expected that all extraction wells will be operated on a nearly continuous basis through 2006 with exceptions to address periodic maintenance needs or planned shut-downs for data collection. All extraction wells will be operated at their maximum sustainable flow rate during 2006. Future water level declines resulting from drought conditions may necessitate further reductions in flow rate from the extraction wells. Conversely, as drought conditions subside and water levels rise in response to increasing recharge, it is anticipated that extraction well flow rates will increase. Decisions regarding future extraction well operations will typically be made annually and presented in an annual report.

Table 9-1 contrasts the design pumping rate versus anticipated long term pumping rates for the recovery wells. As more data is collected, changes in flow rate may also be dictated by a desire to increase the efficiency of solute recovery.

Table 9-1: Design Pumping Rate versus Projected Long Term Pumping Rates

Recovery Well	Design Pumping Rate (gpm)	Projected Long Term Pumping Rate (gpm)
R-1	500	160 – 400
R-2	50	25 – 40
R-3	120	40 – 60
Orton-23	1000	200 – 1200
Mapleton No. 1	1000	850 – 1100

9.3 GAC Treatment System Operations

GAC performance will continue to be assessed through monthly sampling and analysis as described in Section 6.1 of this document. Influent, final effluent and no less than two intermediate samples will be collected monthly.

Operation, maintenance and communication procedures for the GAC treatment systems are established in two documents.

- Granular Activated Carbon Treatment System – Operation, Maintenance & Communications Manual, Spanish Fork GAC Treatment System, Spanish Fork, Utah (Charter Oak, Revised April 2002)

- Granular Activated Carbon Treatment System – Operation, Maintenance & Communications Manual, Mapleton and Orton GAC Treatment Systems, Mapleton, Utah (Charter Oak, Revised April 2002)

These documents are reviewed annually and will be modified as necessary (i.e. contact names and numbers, procedural changes, etc.). These O&M manuals are maintained as separate documents. The latest revised versions of these documents were provided to representatives of Mapleton, Spanish Fork and DWQ in May 2002. In the future, revised documents or replacement pages will be provided on an as-needed basis.

9.4 Extraction System Performance Monitoring

No changes in the extraction system monitoring program are proposed for 2006 or 2007, at this time. Monitoring parameters and frequency are as presented in Table 9-2 and are unchanged from what was proposed in the 2003 Annual Report (Charter Oak, 2004), CAP Addendum (Charter Oak, August 2004b) and 2004 Annual Report (Charter Oak, 2005).

9.4.1 Water Levels

Water levels will typically continue to be measured from operating extraction wells on a weekly frequency during routine weekly extraction well inspections. This approximate frequency is desirable to ensure proper pumping water levels in the extraction wells. During 2006, water levels from observation wells throughout the study area will typically be measured on a bi-monthly frequency; however, deep snow and or muddy surface conditions may preclude the collection of water level data from certain wells. Should hydraulic conditions be observed to change at a more rapid rate than has been experienced in the past, this frequency may be reconsidered. It is anticipated that the bi-monthly measurement frequency will be continued through 2006 and 2007, although modifications to the measurement frequency may be proposed during this period.

9.4.2 Pumping Rates

Pumping rates for individual extraction wells are measured and recorded on an hourly frequency using automated logging equipment. Pumping rates are also typically read directly from the flow meters on a weekly schedule as part of routine extraction well inspection activities. These manual readings are compared to the automated Sensaphone data to determine if there is any drift or undesirable change in the Sensaphone data over time. The manual readings also provide a backup dataset should the Sensaphone equipment become inoperable or if stored data is lost. These data are compiled and reviewed to assess changes in pumping rates over time and to adjust pumping rates in response to changing pumping head conditions. The automated logging system notifies system operators via telephone and facsimile when system upset conditions occur such as when pumping stops at any of the extraction well or wells.

The measurement of pumping rates will continue in this manner during 2006 and 2007.

9.4.3 Water Quality Monitoring

During 2005, extraction wells are being sampled bi-monthly for nitrate-nitrogen and CEMs. No changes to this monitoring program are proposed for 2006 or 2007, at this time. Based on review of the historical data, a bi-monthly sampling frequency will be sufficient to assess extraction well concentration trends. Proposed future changes in the extraction well monitoring program will be presented in the appropriate annual progress report or other correspondence.

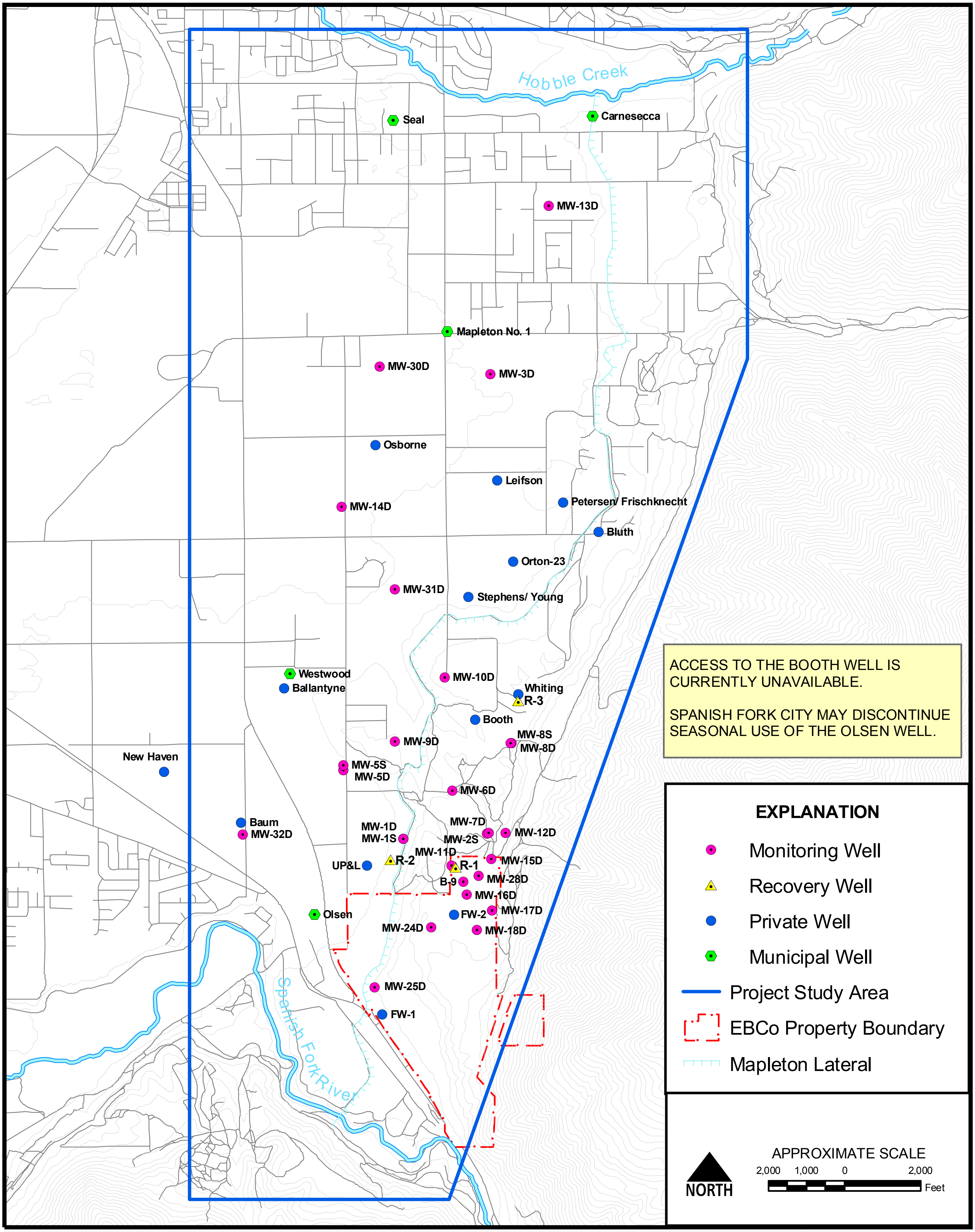
9.5 Ground Water Monitoring Plan

9.5.1 Regional Aquifer Monitoring Program

The monitoring program includes extraction wells, monitoring wells, municipal wells and private wells. Figure 9-1 presents the locations of existing and proposed water level and water quality monitoring locations open to the regional aquifer that will be used for the ongoing assessment of the corrective action. Table 9-2 of this report summarizes the types of data collected and frequency of sampling at each location for calendar years 2006 and 2007. Depending upon factors such as well use, locations, depth and constituent concentrations, the monitoring frequency has varied from monthly to annually. The regional aquifer monitoring program for 2006 and 2007 is the same as presented in the 2004 Annual Report and the CAP Addendum, with the following modifications:

- Upon completion of the pump test in August 2005, the owners of the Booth well requested that EBCo discontinue the sampling of this well and the measurement of water levels. As a result, this well has been removed from the monitoring program. Should access to this well be restored in the future, semi-annual sampling and bi-monthly water level will be resumed. Removal of this well from the monitoring program does not adversely affect the evaluation of water quality conditions in this area. Sufficient coverage is provided by surrounding monitoring locations.

- According to Spanish Fork City representatives, it is unlikely that the Olsen well will be returned to service to supply the city's pressurized irrigation system. The Olsen well cannot be sampled unless the well is in operation. The Olsen well will be sampled at least once for nitrate-nitrogen and CEMs if it is returned to service. The New Haven well and MW-32D provide adequate sampling coverage in this area.



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WELLS INCLUDED IN THE REGIONAL AQUIFER MONITORING PROGRAM

FIGURE 9-1

Table 9-2: Regional Aquifer Ground Water Monitoring Program

Well ID	Water Levels						Nitrate-nitrogen						CEMs					
	W	BM	Q	T	S	A	W	BM	Q	T	S	A	W	BM	Q	T	S	A
R-1	X							X						X				
R-2	X							X						X				
R-3	X							X						X				
Orton-23	X							X						X				
Mapleton No. 1	X							X						X				
MW-1S		X									X						X	
MW-1D		X									X						X	
MW-2S		X									X						X	
MW-3D		X							X						X			
MW-5S		X									X							X
MW-5D		X							X						X			
MW-6D		X									X						X	
MW-7D		X									X						X	
MW-8S		X									X						X	
MW-8D		X									X						X	
MW-9D		X									X							X
MW-10D		X							X						X			
MW-11D		X									X						X	
MW-12		X										X						
MW-13D		X									X							X
MW-14D		X							X						X			
MW-15D		X									X						X	
MW-16D		X									X						X	
MW-17D		X									X						X	
MW-18D		X									X						X	
MW-24D		X									X						X	
MW-25D		X									X						X	
MW-28D		X									X						X	
MW-30D		X							X						X			
MW-31D		X									X							X
MW-32D		X							X						X			
B-9		X									X							X
Westwood									X						X			
Carneseca									X						X			
Seal									X						X			
Olsen[1]										X						X		
Whiting (Joyner)		X									X						X	
UP&L											X						X	
Bluth		X								X						X		
Frischknecht										X						X		
Young		X								X						X		
Osborne									X									
Ballantyne									X									
Booth[2]		X									X						X	
New Haven											X							
Leifson												X						
Baum												X						
FW-1									X						X			
FW-2		X							X						X			

[1]Decisions regarding the future use of this well by Spanish Fork City may preclude the continued sampling of this well.

[2]The current landowners have requested that EBCo not enter the site for the purposes of water level measurements and sampling. It is not known if access rights to this well will be re-established.

W Weekly Frequency
BM Bi-monthly Frequency
Q Quarterly Frequency
T Tri-annual Frequency
S Semi-annual Frequency
A Annual Frequency

At times, certain wells may be inaccessible due to surface conditions or in the case of private wells may not be operating during the winter. EBCo also has no control as to the functionality of private wells and municipal wells. Occasionally, pump systems in monitoring wells require maintenance or replacement. Wells that are functional and accessible will be sampled in accordance with the schedule outlined in the monitoring program. If wells are not functional or accessible during a scheduled sampling event, no sample will be collected and the well will be sampled, if possible, during the next scheduled sampling event. In the case of wells sampled on an annual or semi-annual schedule, samples will be collected during the next scheduled quarterly event.

Due to excavation work associated with ongoing soil interim measures at the EBCo site, regional aquifer monitoring wells MW-16D and MW-18D are temporarily unavailable for sampling due to site conditions. Other on-site wells may also be temporarily unavailable due to the ongoing interim measures. These wells will be sampled as site conditions allow. It is anticipated that at least one round of samples will be collected from these wells during 2006 and that these wells will be available for semi-annual sampling in 2007.

Based on the annual review of the data collected, changes to the regional aquifer monitoring plan may be proposed in the future. Anticipated changes may include reductions or increases in the monitoring frequency of water levels or water quality samples, removal of some CEMs from the analyte list, the addition of new monitoring locations or the permanent removal of some wells from the monitoring program. Proposed changes will typically be addressed in the annual progress report or other correspondence and will not be made without DWQ approval. Table 12-4 of the CAP identifies procedural changes that require DWQ concurrence and those that may be made without DWQ authorization.

9.5.2 Perched Ground Water Monitoring Program

As part of the ongoing RFI, seventeen monitoring wells have been installed that are open to perched ground water identified in the northeast area of the EBCo site (see Figure 4-14). For 2006 and 2007, the monitoring program will be as indicated in Table 9-3. Due to excavation activities related to on-site soil interim measures, monitoring well MW-15S has been abandoned and is no longer available for sampling. Other perched ground water monitoring wells are temporarily unavailable due to ongoing soil excavation work at the EBCo site. These wells will be sampled as site conditions allow. It is anticipated that at least one round of samples will be collected from some or all of these wells during 2006 and that these wells will be available for semi-annual sampling in 2007.

Modifications to the perched ground water monitoring program (locations, frequency, and parameter list) may be proposed in the future. Such changes will not be made without the approval of the DEQ.

Table 9-3: Perched Ground Water Monitoring Program

Well ID	Water Levels					Nitrate					Sulfate					CEMs				
	BM	Q	T	S	A	BM	Q	T	S	A	BM	Q	T	S	A	BM	Q	T	S	A
MW-15S	Monitoring Well Abandoned in September 2005																			
MW-16S	X								X					X					X	
MW-17S	X								X					X					X	
MW-18S	X								X					X					X	
MW-19S	X								X					X					X	
MW-21S	X								X					X					X	
MW-22S	X								X					X					X	
MW-23S	X								X					X					X	
MW-27S	X								X					X					X	
MW-28S	X								X					X					X	
MW-29S	X								X					X					X	
MW-33S	X								X					X					X	
MW-34S	X								X					X					X	
MW-35S	X								X					X					X	
MW-36S	X								X					X					X	
MW-37S	X								X					X					X	
MW-38S	X								X					X					X	

BM Bi-monthly Frequency
Q Quarterly Frequency
T Tri-annual Frequency
S Semi-annual Frequency
A Annual Frequency

9.5.3 Assessment of Provisional Constituents of Concern

In a letter dated July 7, 2004, DWQ concurred with EBCo's recommendation to eliminate 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NG and dissolved lead as provisional constituents of concern in the regional aquifer. While dissolved lead has been eliminated from the monitoring program, the four CEMs will continue to be analyzed and reported as part of the routine laboratory analysis.

9.6 Institutional Controls Program

No changes to the institutional controls program are proposed at this time.

9.7 Progress Reporting

The timing, format and content of routine project progress reporting are the subject of ongoing discussions between the DWQ and EBCo. The content of the 2005 Annual Report has been developed based, in part, on these ongoing discussions. We anticipate that the 2006 Annual Report will be submitted to DWQ by April 30, 2007. Once additional reporting requirements are established the progress reporting schedule and content will be adjusted accordingly.

10.0 ITEMS REQUIRING DWQ RESPONSE

No changes requiring DWQ response are proposed for the ground water extraction system, water treatment systems or monitoring program in the 2005 Annual Report.

11.0 REFERENCES

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APPENDIX A

NITRATE-NITROGEN AND CEM DATA SUMMARY

REGIONAL AQUIFER AND PERCHED GROUND WATER

APPENDIX B

MANN-KENDALL TEST RESULTS

REGIONAL AQUIFER AND PERCHED GROUND WATER

APPENDIX C

WATER LEVEL ELEVATION DATA USED FOR HYDROGRAPHS

REGIONAL AQUIFER AND PERCHED GROUND WATER

APPENDIX D

CD-ROM CONTAINING SCANNED 2005 LABORATORY REPORTS OF WATER QUALITY DATA